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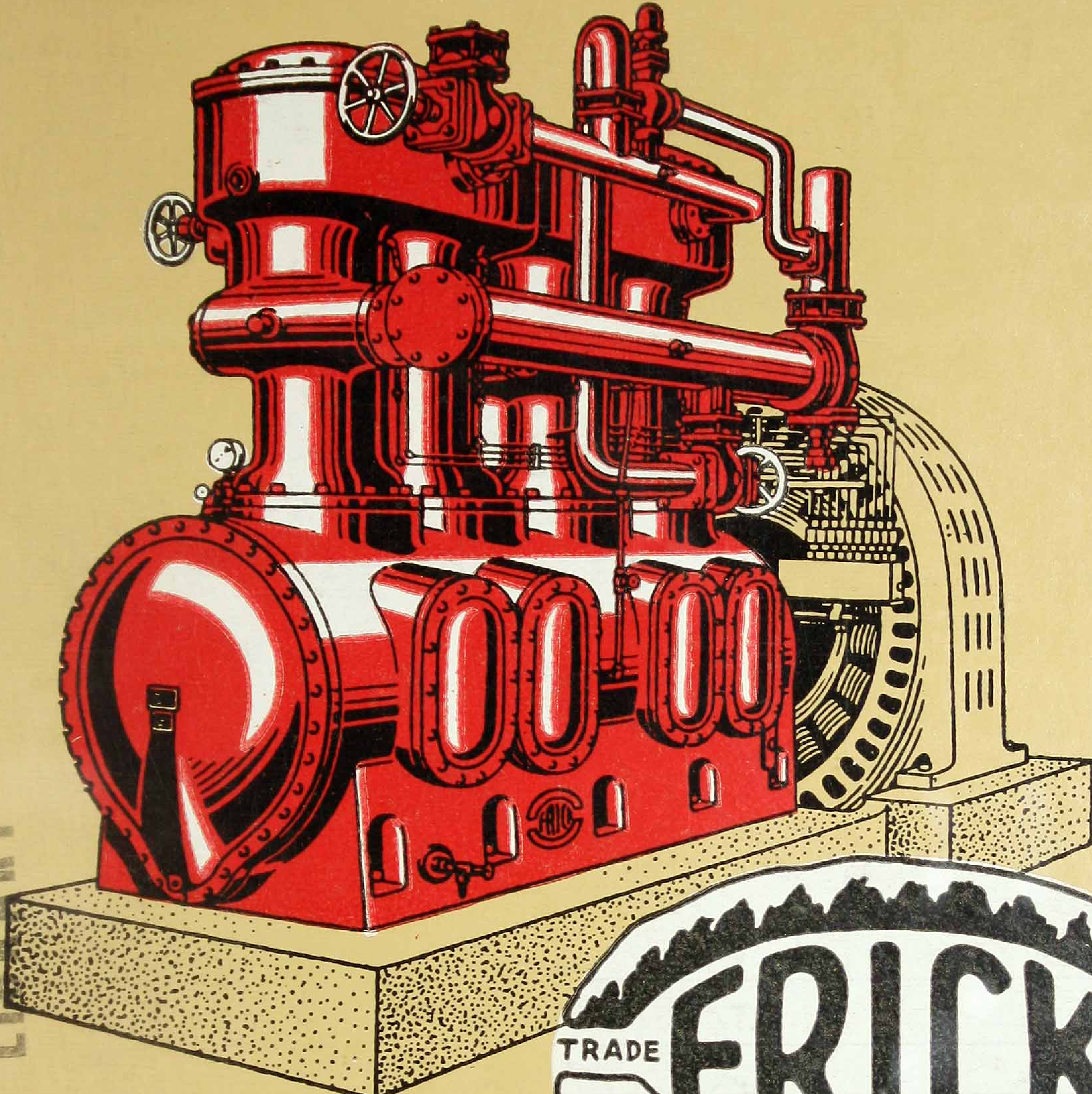


TRADE FRICK MARK

Refrigerating, Ice-making, and Air Conditioning Equipment

Refrigeration

Bulletin 80-B

Useful Refrigeration Tables

TABLE A. CONDENSED LIST OF STORAGE TEMPERATURES

Products	How Packed	Temp., °F.	Products	How Packed	Temp., °F.
Almonds	In shells	34°—38°	Grapefruit	Boxes	35°—40°
Apples	Barrels	30°—32°	Hams, etc.	Cured	35°—40°
Apricots	Baskets	40°—45°	Hominy	Boxes	35°—40°
Beans	Green, bushel baskets	36°—40°	Lard	Barrels or cans	36°—40°
Berries	Short periods, 3 or 4 days	36°—40°	Lemons, Limes	Boxes	35°—40°
Butter	Boxes or crates	38°—40°	Lettuce	Bushel crates	35°—37°
Cabbage	Bulk	32°—36°	Maple Sugar	Boxes, or Syrup	40°—45°
Cabbage	Boxes or Crates	32°—33°	Meat	Frozen	0°— 5°
Calves	Fresh, held in chill	30°—36°	Meat	In chill	30°—32°
Calves	Fresh, short time	36°—38°	Meat	In cooler	36°—38°
Candy	Bulk or boxed	60°—65°	Meat	Cured or smoked	40°—45°
Canteloupes	Box or crate, 3 weeks	34°—36°	Milk	Fresh, 40 qt. cans or bottles	38°—40°
Carrots	Bushel crates	34°—40°	Milk	Condensed	36°—40°
Cherries	Fresh, in boxes or crates	36°—40°	Molasses	Barrels	40°—45°
Cherries	Frozen	0°— 5°	Mutton	Fresh, short period	30°—32°
Cereal foods	Finished packages	40°—45°	Nuts	In shells	35°—40°
Cheese	Cream, Limburger, etc.	38°—40°	Oils, lard, cottonseed, etc.	Barrels or cans	35°—40°
Codfish	Dried	40°—45°	Oleomargarine	Boxes	25°—30°
Condensed Milk	Bulk	36°—40°	Olive Oil	Barrels	35°—40°
Corn	Green, bushel crates	36°—40°	Onions	Sacks	32°—36°
Corn	Dried, sacks	40°—45°	Oranges	Boxes	35°—40°
Cream	Fresh, 40 qt. cans	32°—36°	Oysters	In shells, sack	36°—42°
Cream	Condensed	36°—40°	Oysters	In tubs or cans	30°—34°
Currants	In boxes	36°—40°	Peaches & Pears	Bushel baskets	35°—40°
Dates	Cured, boxes	40°—45°	Peas	Green, bushel crates	36°—40°
Eggs	Crates, 30 dozen	28°—30°	Pineapples, Plums	Boxes	40°—45°
Figs	Dried	40°—45°	Poultry	In freezer	0°—10°
Fish	Fresh, short periods	25°—30°	Poultry	Cooler, short period	36°—38°
Fish	Frozen, regular storing	0°—10°	Potatoes	Sacks	34°—38°
Fish	Dried, in boxes or bbls.	35°—40°	Rice	Sacks	40°—45°
Flour	Any Kind, from cereals	35°—40°	Serums	Vials or bottles	40°—50°
Fruit	Usual boxes or baskets	35°—40°	Skins	Dried	25°—30°
Fruits & Veg.	Dried	40°—45°	Skins	Uncured	30°—35°
Furs	Coats, for summer season	25°—30°	Strawberries	Qt. boxes, crated	36°—40°
Furs	Rugs of animals, or stuffed	25°—30°	Vegetables	In barrels or crates	36°—40°
Game	Frozen	0°—10°	Watermelons	Short period	34°—36°
Game	In cooler, short period	25°—30°	Wines	Barrels	40°—45°
Grapes	Large baskets	34°—40°			

TABLE B. PROPERTIES OF BRINES — From A. S. R. E. Tables

Solutions of Chloride of Calcium ($CaCl_2$)

B-1 Per Cent of Pure Salt by Weight	B-2 Freezing Point, °F.	B-3 Ammonia Gauge Pressure, Lb., at Freezing Point	B-4 Specific Gravity † 60°F. † 39°F.	B-5 Baume Density 60°F.	B-6 Specific Heat B. t. u. per Lb., /°F. at 60° F.	B-7 Weight in Lb. per Cu. Ft. — B-8 $CaCl_2$	B-9 Brine
0	32.0	47.6	1.000	0.0	1.000	0.00	62.40
5	29.0	43.8	1.044	6.1	0.9246	3.26	65.15
6	28.0	42.6	1.050	7.0	.9143	3.93	65.52
7	27.0	41.4	1.060	8.2	.8984	4.63	66.14
8	25.5	39.0	1.069	9.3	.8842	5.34	66.70
9	24.0	37.9	1.078	10.4	.8699	6.05	67.27
10	23.0	36.8	1.087	11.6	.8556	6.78	67.83
11	21.5	35.0	1.096	12.6	.8429	7.52	68.33
12	19.0	32.5	1.105	13.8	.8284	8.27	68.95
13	17.0	30.4	1.114	14.8	.8166	9.04	69.51
14	14.5	28.0	1.124	15.9	.8043	9.81	70.08
15	12.5	26.0	1.133	16.9	.793	10.6	70.64
16	9.5	23.4	1.143	18.0	.7798	11.4	71.26
17	6.5	20.8	1.152	19.1	.7672	12.22	71.89
18	3.0	18.0	1.162	20.2	.7566	13.05	72.51
19	0.0	15.7	1.172	21.3	.746	13.9	73.13
20	— 3.0	13.6	1.182	22.1	.7375	14.73	73.63
21	— 5.5	11.9	1.192	23.0	.729	15.58	74.19
22	—10.5	8.8	1.202	24.4	.7168	16.50	75.0
23	—15.5	5.9	1.212	25.5	.7076	17.4	75.63
24	—20.5	3.4	1.223	26.4	.6979	13.32	76.32
25	—25.0	1.3	1.233	27.4	.6899	19.24	76.94
26	—30.0	1.6*	1.244	28.3	.682	20.17	77.56
27	—36.0	6.1*	1.254	29.3	.6735	21.13	78.25
28	—43.5	10.6*	1.265	30.4	.6657	22.1	78.94
29	—53.0	15.7*	1.276	31.4	.6584	23.09	79.62
29.5	—58.0	17.8*	1.280	31.7	.6557	23.56	79.87

Solutions of Chloride of Sodium (NaCl) (Common Salt)

B-10 Freezing Point, °F.	B-11 Ammonia Gauge Pressure, Lb., at Freezing Point	B-12 Specific Gravity † 39°F. † 39°F.	B-13 Baume Density 60°F.	B-14 Salometer 39°F. † 39°F.	B-15 Specific Heat B. t. u. per Lb. /°F. at 39°	B-16 Weight in Lb. per Cu. Ft. — B-17 NaCl	B-18 Brine
32.0	47.6	1.000	0.0	0.0	1.000	0.000	62.4
27.0	41.4	1.035	5.1	18.2	0.938	3.230	64.6
25.5	39.6	1.043	6.1	22.5	0.927	3.906	65.1
24.0	37.9	1.050	7.0	26.0	0.917	4.585	65.5
23.2	37.0	1.057	8.0	29.6	0.907	5.280	66.0
21.8	35.6	1.065	9.	33.5	0.897	5.985	66.5
20.4	34.1	1.072	10.1	37.2	0.888	6.690	66.9
18.5	32.0	1.080	10.8	41.1	0.879	7.414	67.4
17.2	30.6	1.087	11.8	44.8	0.870	8.136	67.8
15.5	28.9	1.095	12.7	48.7	0.862	8.879	68.3
13.9	27.4	1.103	13.6	52.6	0.854	9.632	68.8
12.0	25.6	1.111	14.5	56.8	0.847	10.395	69.3
10.2	24.0	1.118	15.4	60.0	0.840	11.168	69.8
8.2	22.3	1.126	16.3	64.0	0.833	11.951	70.3
6.1	20.5	1.134	17.2	68.0	0.826	12.744	70.8
4.0	18.8	1.142	18.1	71.7	0.819	13.547	71.3
1.8	17.1	1.150	19.0	75.2	0.813	14.360	71.8
—0.8	15.1	1.158	19.9	79.1	0.807	15.183	72.3
—3.0	13.6	1.166	20.8	82.8	0.802	16.016	72.8
—6.0x	11.6	1.175	21.7	86.8	0.796	16.854	73.3
3.8	18.6	1.183	22.5	90.2	0.791	17.712	73.8
16.1	29.5	1.191	23.4	94.0	0.786	18.575	74.3
32.0	47.6	1.200	....	....	....	....	....

†Specific Gravity and Weights at 39° referred to water at 39°F.
Note: Weight given for pure Na Cl salt can be used for commercial salt with a theoretical error of about 1 %.
X Eutectic Point: addition of more salt raises the freezing point.

†Specific Gravity and Weights at 60°F. referred to water at 39°F. * Inches Vacuum. Column showing % salt by weight applies to both tables. Note: To get weight of commercial salt divide the values given for anhydrous salt in the table by the per cent purity of the commercial calcium salt. A calcium brine freezing at 0° and requiring 13.9 pounds of "pure" salt per cubic foot will require 73 into 13.9 equals 19 pounds of 73% salt. To get weights of water for other than anhydrous salt subtract the weight of that salt, as just determined, from the weight of the brine. (73.13—19 equals 54:13)

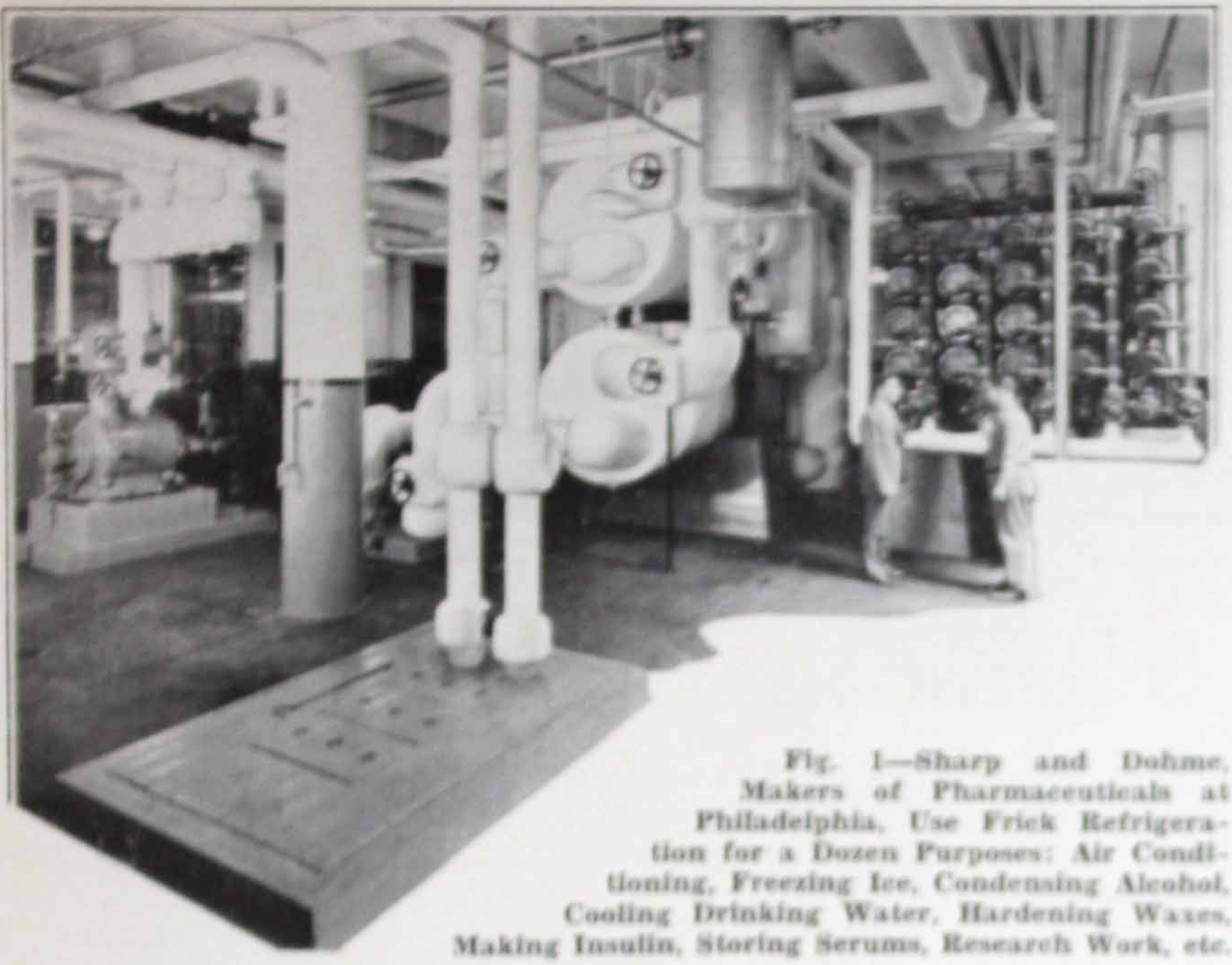


Fig. 1—Sharp and Dohme, Makers of Pharmaceuticals at Philadelphia, Use Frick Refrigeration for a Dozen Purposes: Air Conditioning, Freezing Ice, Condensing Alcohol, Cooling Drinking Water, Hardening Waxes, Making Insulin, Storing Serums, Research Work, etc.

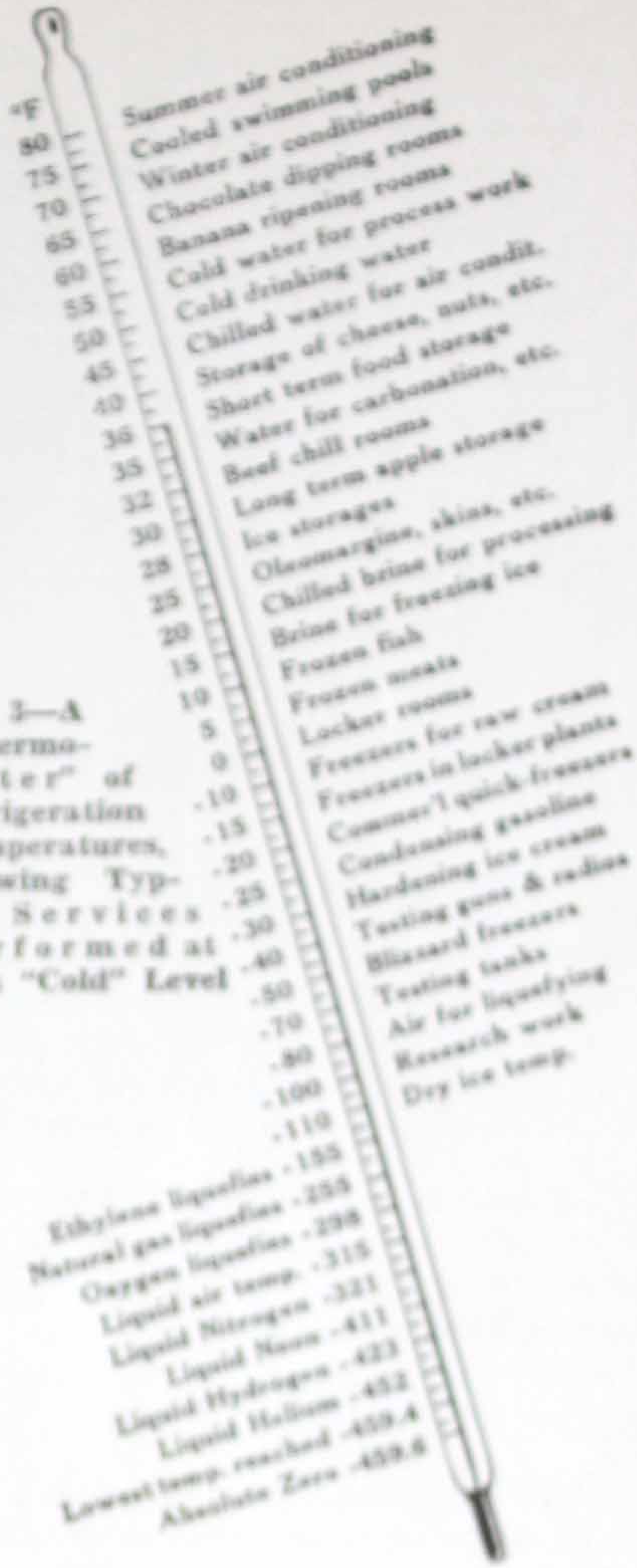


Fig. 3—A "Thermometer" of Refrigeration Temperatures, Showing Typical Services Performed at each "Cold" Level

Uses of Frick Refrigeration

More than 200 businesses and industries, some of which are illustrated in this bulletin, find Frick refrigeration an indispensable aid in giving better service—and earning better profits.

Frick machines are used by the thousands for cooling rooms, refrigerators, display cases, etc., in such places as markets, grocery stores, restaurants, hotels, hospitals, clubs, institutions, flower shops, laboratories, and aboard ship. Note list on inside front cover showing articles that are held in storages (many of them of great size) with Frick equipment. See also back cover for list of uses of Frick refrigeration.

The machines supply cold water for drinking purposes, as well as for bottling and baking plants, and other industrial processes. They do air conditioning, freeze ice and ice cream, chill meats, quick-freeze various foods, temper steel, and control temperatures in plants making explosives, candy, rubber, rayon, serums, and beer. Our Engineers are, furthermore, constantly solving special cooling problems to meet the needs of customers.

Fig. 2—Hotels like the National at Havana Use Frick Equipment for Cooling from 2 to 25 Refrigerators, Making Ice, Circulating Cold Drinking Water, Freezing Desserts, Dispensing Beverages, and Air Conditioning.

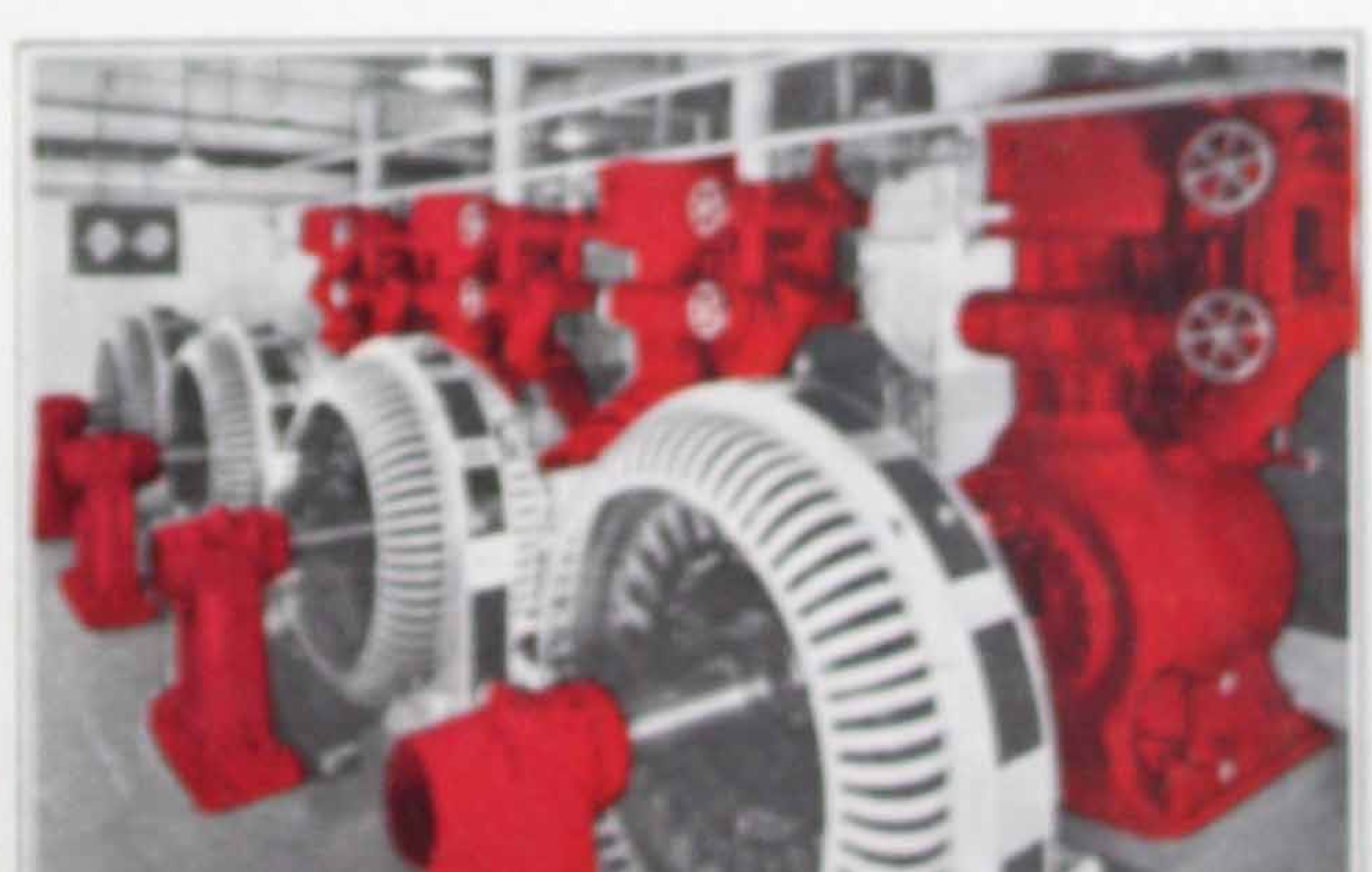


Fig. 4—These Four Frick 12" by 12" Ammonia Compressors Supply 1000 Tons of Refrigeration for Air Conditioning 2 Large Office Buildings at Tulsa, Oklahoma.

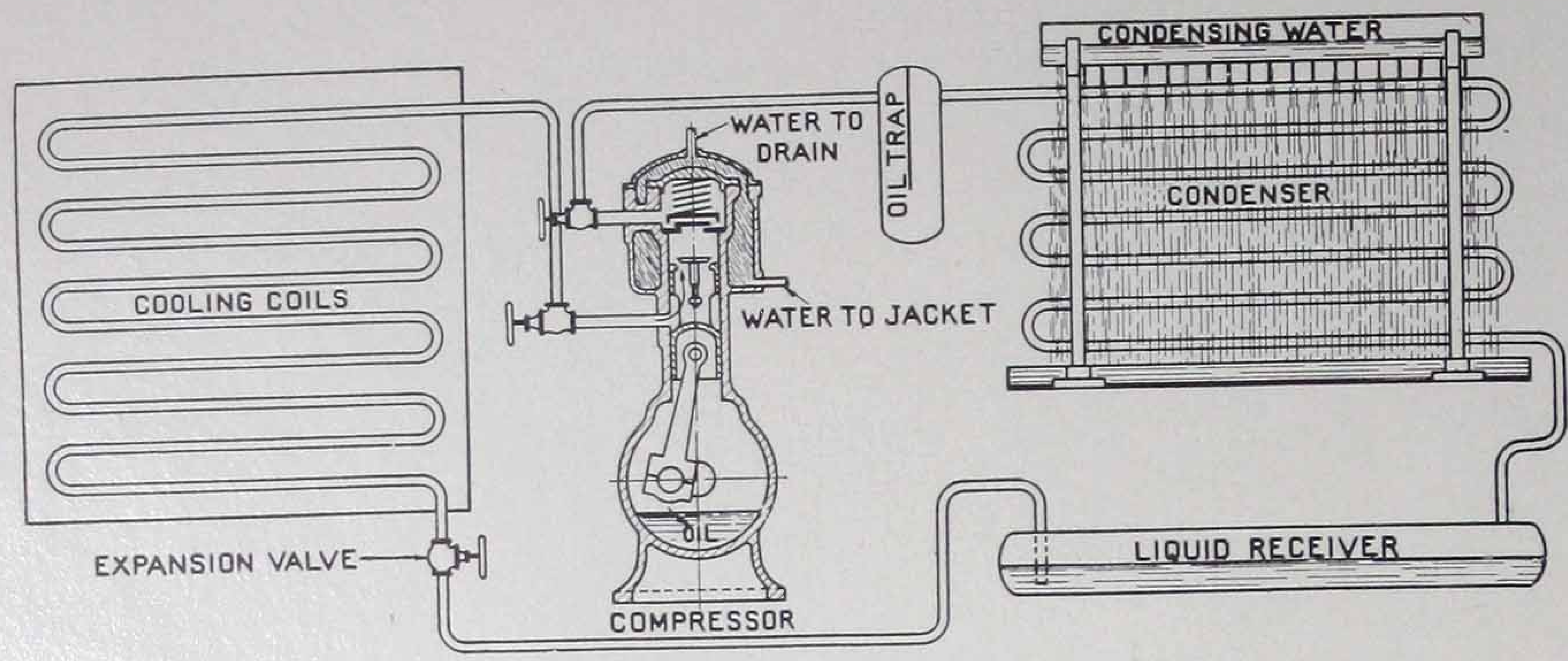


Fig. 5—Diagram of the Elementary Refrigerating Cycle, Using the Compression System

Principles of Refrigeration

The essential parts of a refrigerating plant are the compressor, condenser, receiver, expansion valve, and cooling coils: suitable pipe lines, with the necessary shut-off valves, connect one part to another. For the sake of simplicity, the operation of an ammonia system will be outlined. Freon-12, methyl chloride and carbon dioxide systems work on the same principle, but at different suction and discharge pressures.

The air is first pumped out and the system is then charged with ammonia—a clear liquid looking like water. While water boils at a temperature of 212 degrees in the open air, ammonia under atmospheric pressure will boil at 28 degrees below zero F. Ammonia has a strong suffocating odor, but is not poisonous and can be used with entire safety in properly made equipment.

The liquid ammonia is held in the receiver under about 185 lb. gauge pressure, and from there is fed into the cooling coils in a fine stream by means of a regulating or expansion valve. In the same way that boiling water absorbs heat from a fire, and sends it off in the form of the gas we call steam, the liquid ammonia takes up the heat from the pipe coils and evaporates into ammonia gas. By constantly drawing off the gas from the pipe coils, we make them so cold that they chill the air and products around them, and by condensing and freezing part of the moisture in the air, produce the white frost often seen on the pipes.

As fast as the ammonia gas is formed it is drawn into the compressor, which maintains an average "suction pressure" in the coils of 6 to 35 pounds. The compressor, which is really a gas pump designed for handling ammonia, raises the pressure of the ammonia gas to about 185 pounds again, and forces it into the condenser. The work done on the gas has meanwhile raised its temperature to say 200 degrees F. In the condenser the hot ammonia is cooled by tubes carrying cold water, the effect of which is to change the gas back to liquid form, ready for returning to the receiver and being used again.

The power required for driving the compressor is less, in proportion to the cooling effect, if the suction pressure is kept as high as possible (while still producing the cold temperatures desired). By feeding the refrigerant into the bottom of the coils or coolers they can be kept "flooded" with liquid ammonia: flooded operation naturally increases the heat transfer and maintains a higher suction pressure. Suitable float valves, automatic expansion valves, and electric control valves are now generally used in place of hand expansion valves, for governing the ammonia feed. Thermostats and special electric controls are similarly used for starting and stopping the compressor automatically, when desired. Self-opening unloaders can be used to relieve the head pressure, on large machines, until they have come up to speed. For efficient operation the head or condensing pressure should of course be kept as low as the use of ample cold water and generous tube surfaces in the condenser will economically allow.

The capacity of a refrigerating machine depends largely upon the number and size of its cylinders, its speed when running, the efficiency of compression, the suction and discharge pressures, and the number of hours of operation per day, the rated capacity being always based on continuous operation through the 24 hours. Machine ratings are usually based on the conditions adopted as standard by the American Society of Refrigerating Engineers, which are 5 deg. F. and 19.6 lb. gauge pressure for the suction, and 86 deg. F. and 154.5 lb. gauge for the discharge.

To produce a ton of refrigeration, the number of cubic feet of ammonia gas which must be handled by the compressor, per minute, decreases rapidly as the suction pressure rises. As a result, the capacity of a machine operated at 23.81 lb. suction is more than twice that when running at 4 lb.

One Ton of Refrigeration is about equal to the cooling effect obtained when a ton of ice, weighing 2000 pounds, is melted in 24 hours. To be exact, 1 T. R. equals 288,000 British thermal units (or B. t. u.) per 24 hours. This is cooling at the rate of 200 B. t. u. per minute. It is usually figured that from 1.4 to 1.6 tons of refrigeration are required to make one ton of ice, as the water must first be cooled to the freezing point, and various other losses have to be considered.

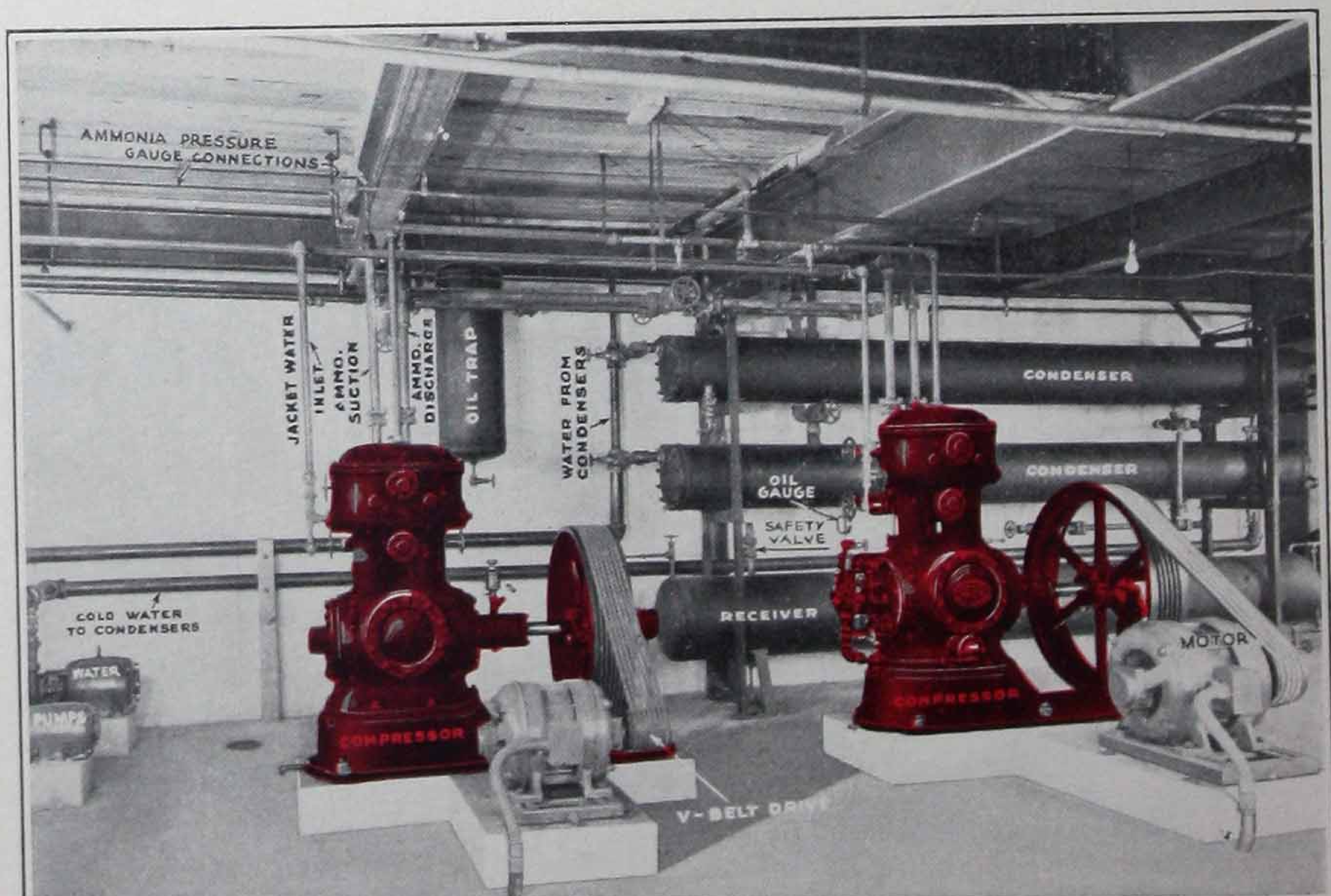


Fig. 6—Showing the Parts of the High-Pressure Side of a Typical Refrigerating Plant, Using Two Compressors, with Shell-and-Tube Condensers.

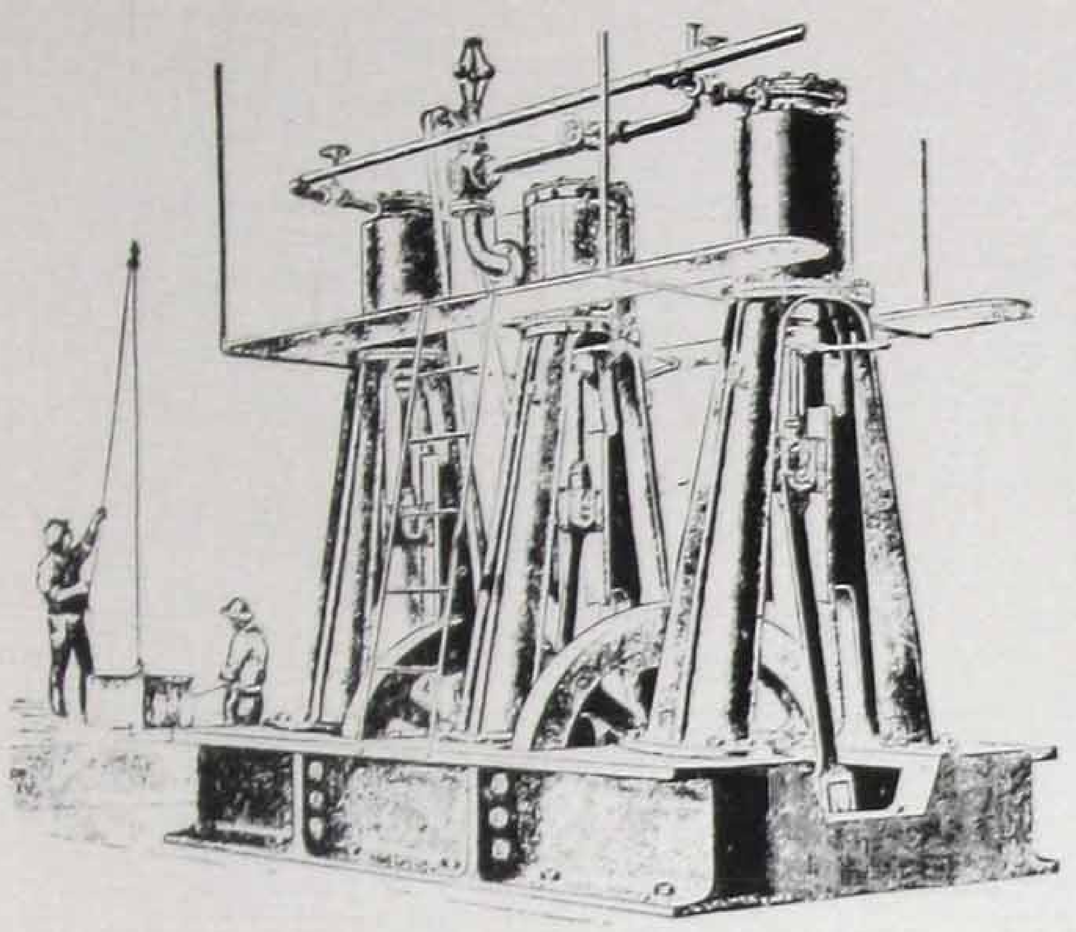


Fig. 7—The First Complete Frick Refrigerating Machine had this Vertical Design.

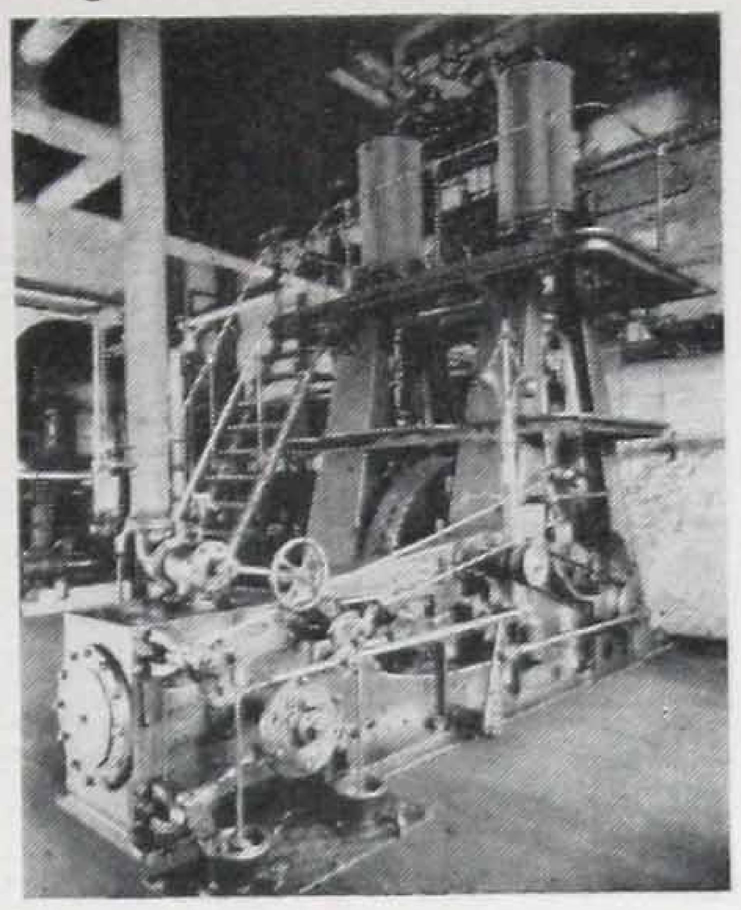


Fig. 8—Engine-driven Machine in operation at Gipps Brewery, Peoria, Ill., Since 1887.

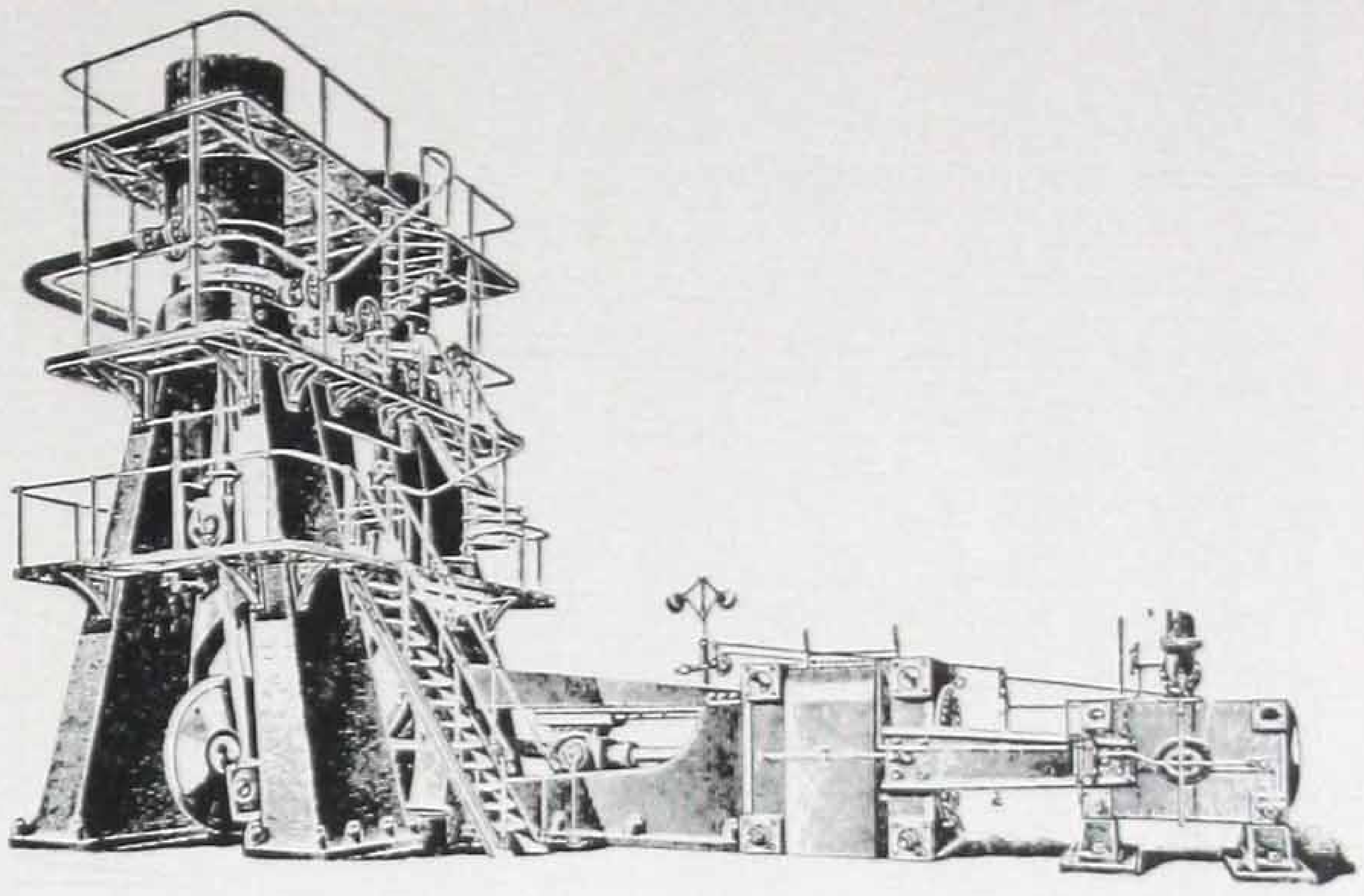


Fig. 9 — 27"x48" Compressor—then World's Largest —Installed at Kansas City in 1896. Now in Reserve Service.

Features Applying to All Frick Machines

Frick equipment has back of it the experience and resources of a long-established firm, which has pioneered in the development of mechanical refrigeration, ice-making, and air conditioning.

This Company was established in 1853 by George Frick, who several years earlier had begun making steam engines. Frick portable and Corliss engines having achieved world-wide recognition, the Company in 1882 started building ammonia compressors, and has continued to be a leader in the refrigeration field ever since. As early as 1890 Frick machines were being exported to other countries; today they are found throughout the civilized world.

The Works of the Company at Waynesboro are divided into 35 specialized departments, including pattern shop, foundry, machine shops, pipe shops, tank shop, welding department, etc. The metals used in making castings are tested daily in the metallurgical laboratory.

Every part of the machinery is given repeated inspections and tests by a force of specialists in this work, equipped with precision instruments. All wearing parts are made to standard gauges, accurate to a fraction of a thousandth of an inch, and are thus interchangeable. Columns, valves, coils and vessels are tested with 150 to 300 lb. of air pressure, under water. The assembled machines are given a thorough test run; they are then cleaned again and oiled, before being packed for shipment. The completed machines pass all local and government requirements, known to us, for safety.

Machinery to be exported is mounted on skids of ample size and stoutly boxed; small parts are separately marked and boxed. Waynesboro is within easy distance by rail to the ports of New York, Philadelphia and Baltimore.

Our standard warranty, applying to all Frick equipment reads:

If a defect is claimed, we will furnish f. o. b. Waynesboro, Pa., a new part or parts to replace the part or parts claimed to be defective, charging them f. o. b. factory in the usual manner, and on receipt of the part or parts claimed to be defective, if upon inspection and test it appears that they are defective, we will issue a credit in an equal amount, less any unpaid transportation charges. In case of defects our responsibility is limited to the value of the defective parts and we do not assume consequential damages.

Fig. 10—The Frick Foundry Makes Iron and Semi-Steel Castings up to the Largest Sizes.

Fig. 11 — Assembly Floor of the Waynesboro Shops, Showing Machines of Various Types.

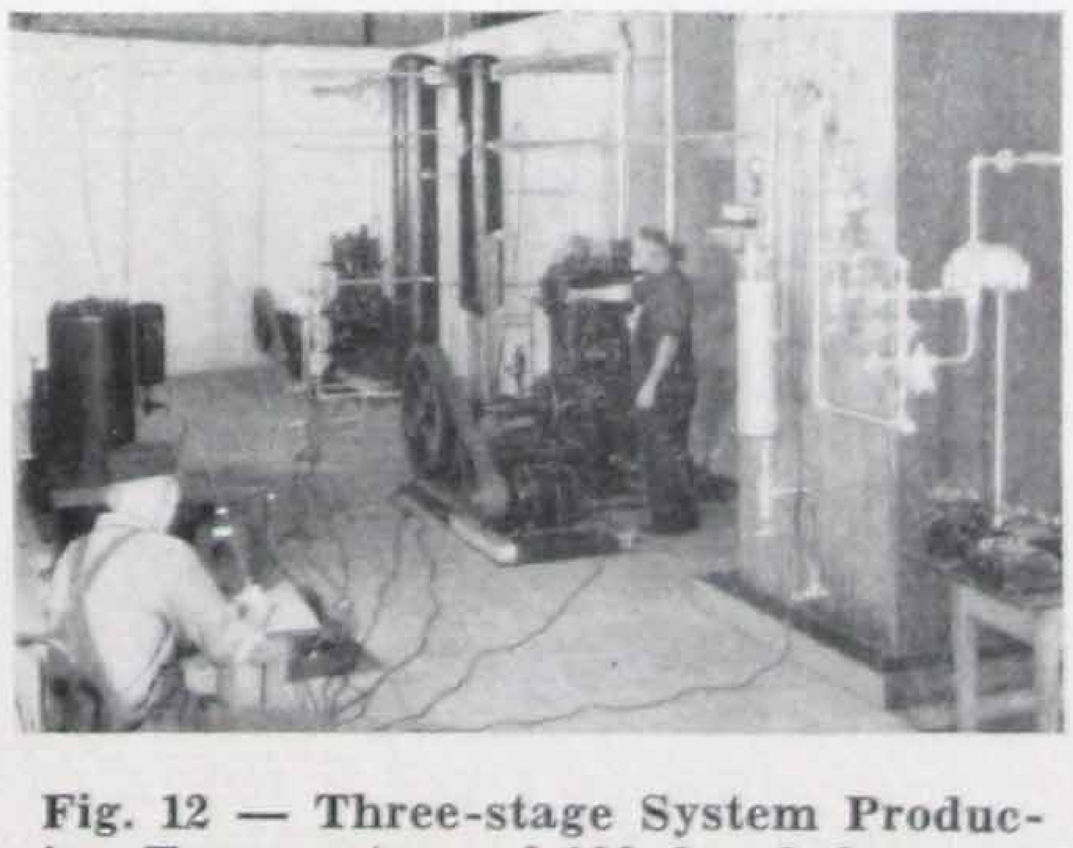


Fig. 12 — Three-stage System Producing Temperature of 100 deg. below zero F., in the Research Laboratory.

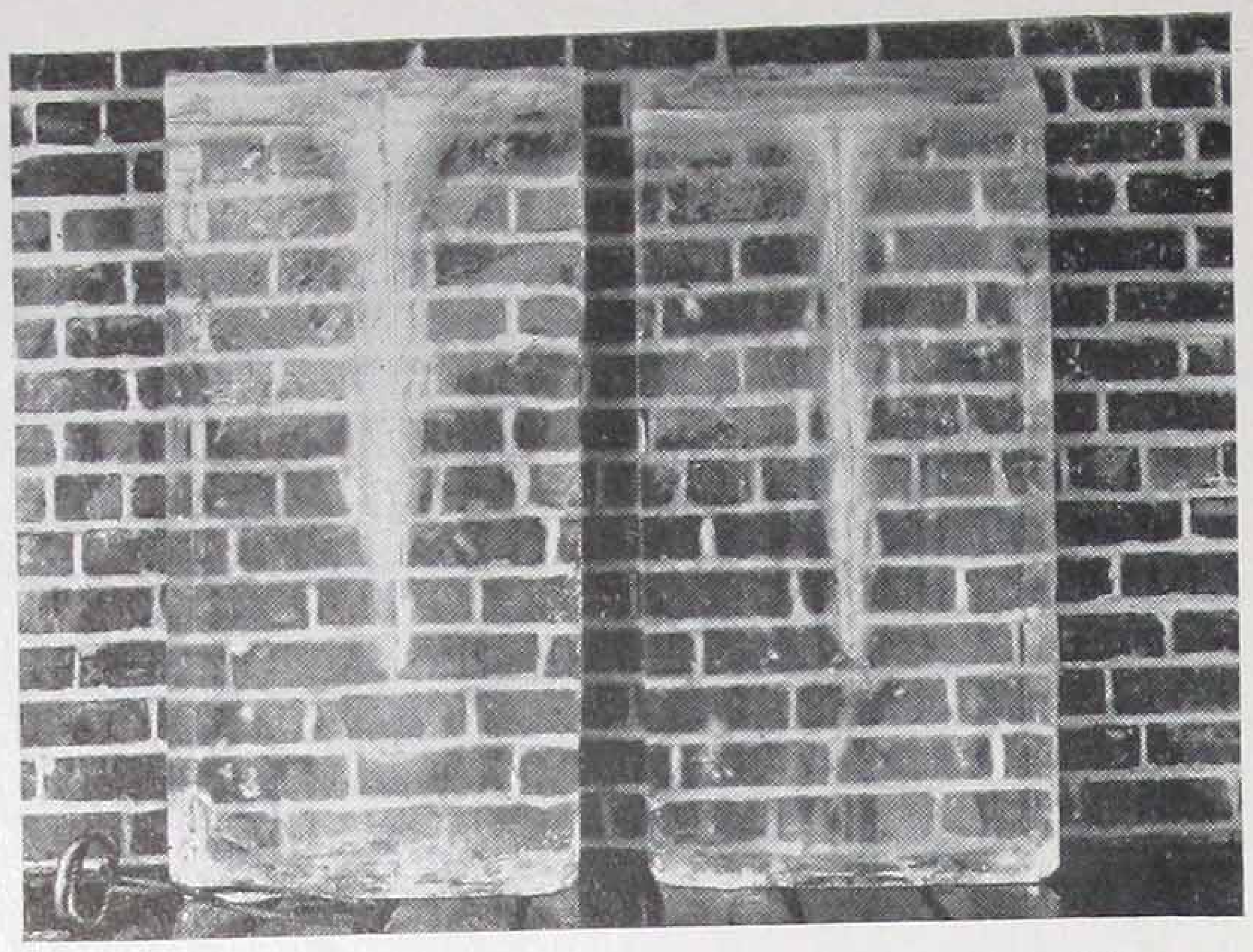


Fig. 13—Clear Ice Made from Untreated Water by the Patented Frick-Pendulum System.

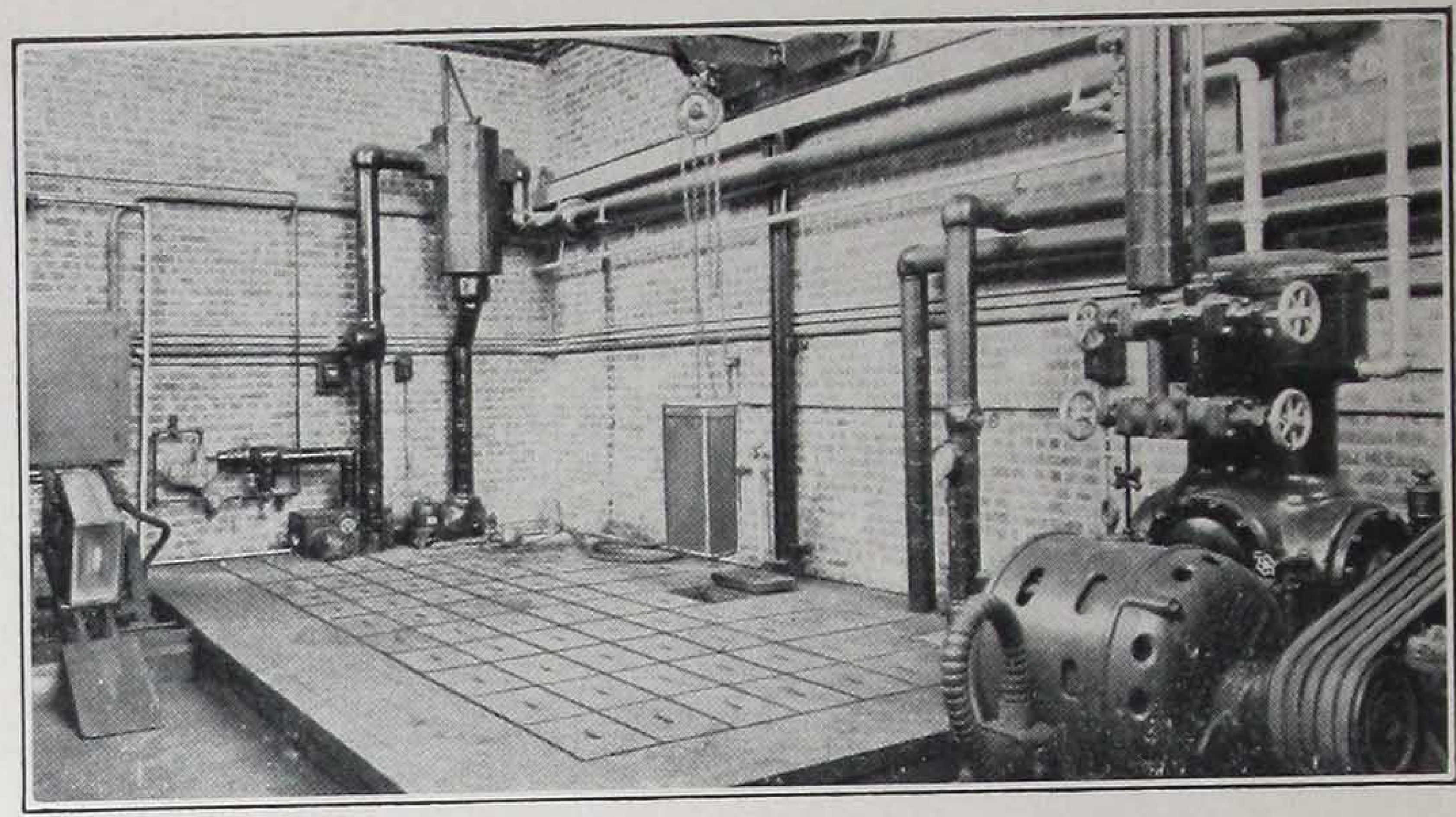


Fig. 16 — Typical Small Ice-Making Factory, showing Compressor and Main Parts of the System.

Ice-Making Systems

Principle of Making Ice Ice is made by freezing water in galvanized cans, which are lowered into a tank filled with salt brine. The brine is cooled to about 16° F. by ammonia coils connected to the refrigerating machine.

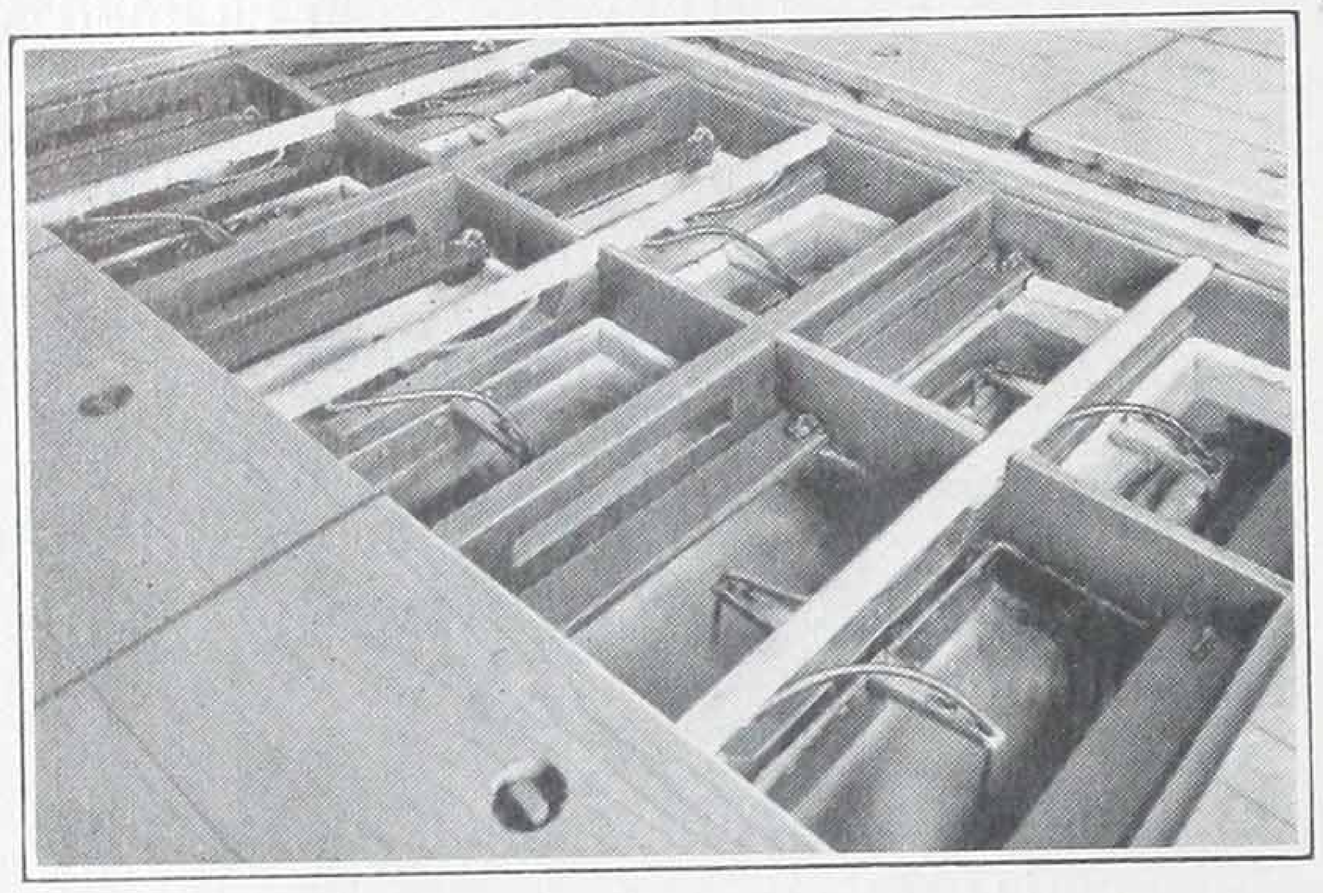


Fig. 14 — Framework, Covers, Laterals, Brackets and Drop Tubes, as Used in the F-P System.

Raw Water Ice To produce clear ice we must either distill the water before freezing it or use raw untreated water and bubble up through it a stream of air (supplied by an air blower) by means of a brass tube inside the can. The resulting agitation of the water washes the air bubbles and impurities from the surface of the ice while freezing. The impurities collect in the central core at the middle of the block, to be drawn off, if desired, by the core sucker, the space being refilled with fresh water.

Group lift equipment, pictured in Figs. 31 and 71, is recommended for ice tanks of considerable size.

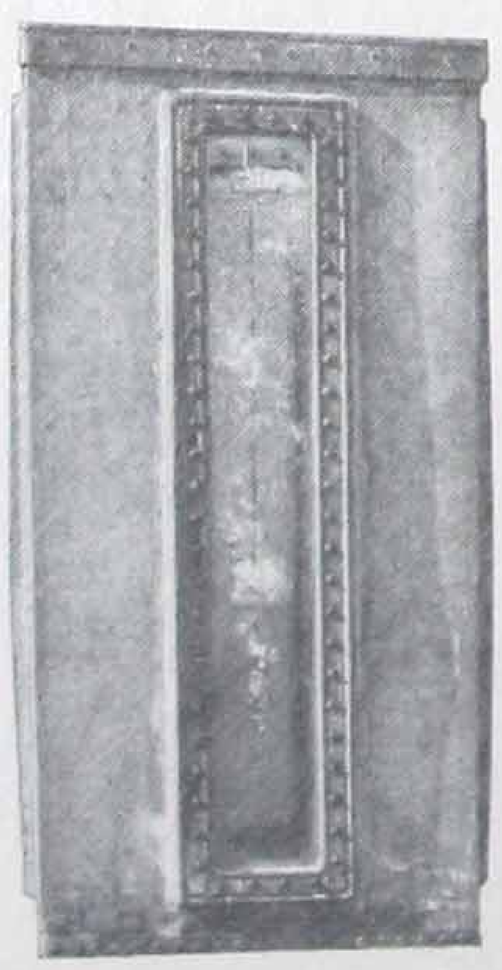


Fig. 15 — Ice Can Made with Glass Windows to show Air Agitation Caused by Perforated F-P Tube.

F-P System In this patented System, now used in more than 1000 ice plants, the air tube is suspended from a pivot. It swings with a pendulum motion across the width of the can only, scouring each ice surface thoroughly in turn, and always freezing in the center of block. Small holes permit agitation after the bottom of the tube is frozen shut, or the blower has been stopped, by accident, for even half an hour. Besides making the finest quality crystal ice, the Frick-Pendulum (F-P) System, as well as the plain Frick air system, saves the expense of air drying equipment, for the blower draws air from under the tank framework, and by recirculation the air is kept cool. Also, the blower supplies air at a pressure of two pounds or less, thus saving much power over that required for an air compressor. The F-P System represents the highest development in equipment to make clear ice and is the standard of comparison for the entire industry.

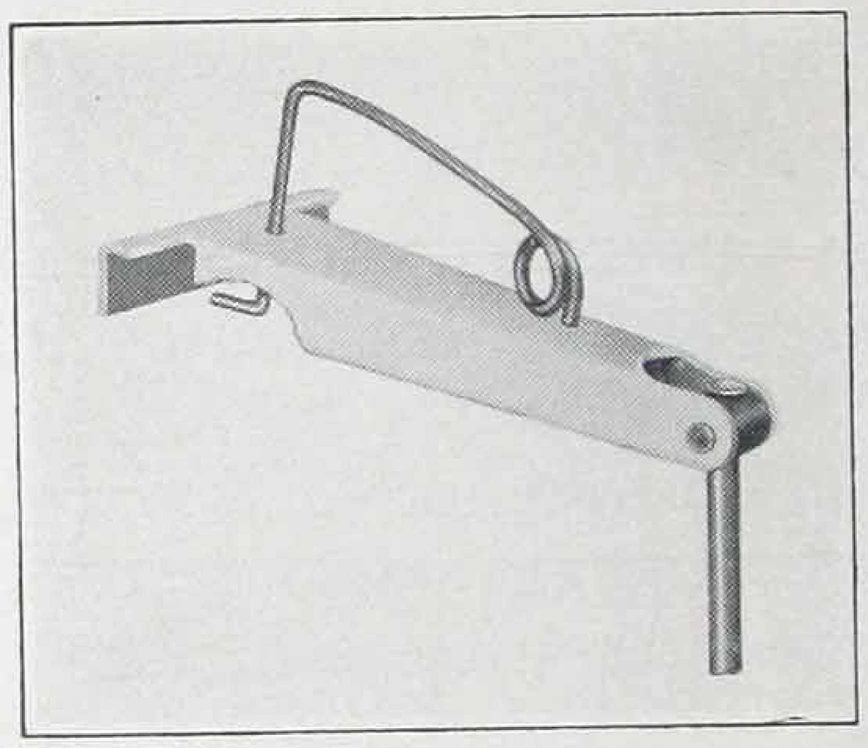


Fig. 17 — F-P Bracket and Tube

Ice Tank The smallest tanks are made of 3/16-inch steel and are riveted up or welded before shipment: larger sizes employ ¼-inch plate and are shipped knocked down.

Flooded System The coils work most efficiently when partly filled with liquid ammonia: to keep any liquid from coming over to the refrigerating machine, a separator or "accumulator" is installed in the suction pipe, and the liquid caught by it is drained back into the coils. See Fig. 19.

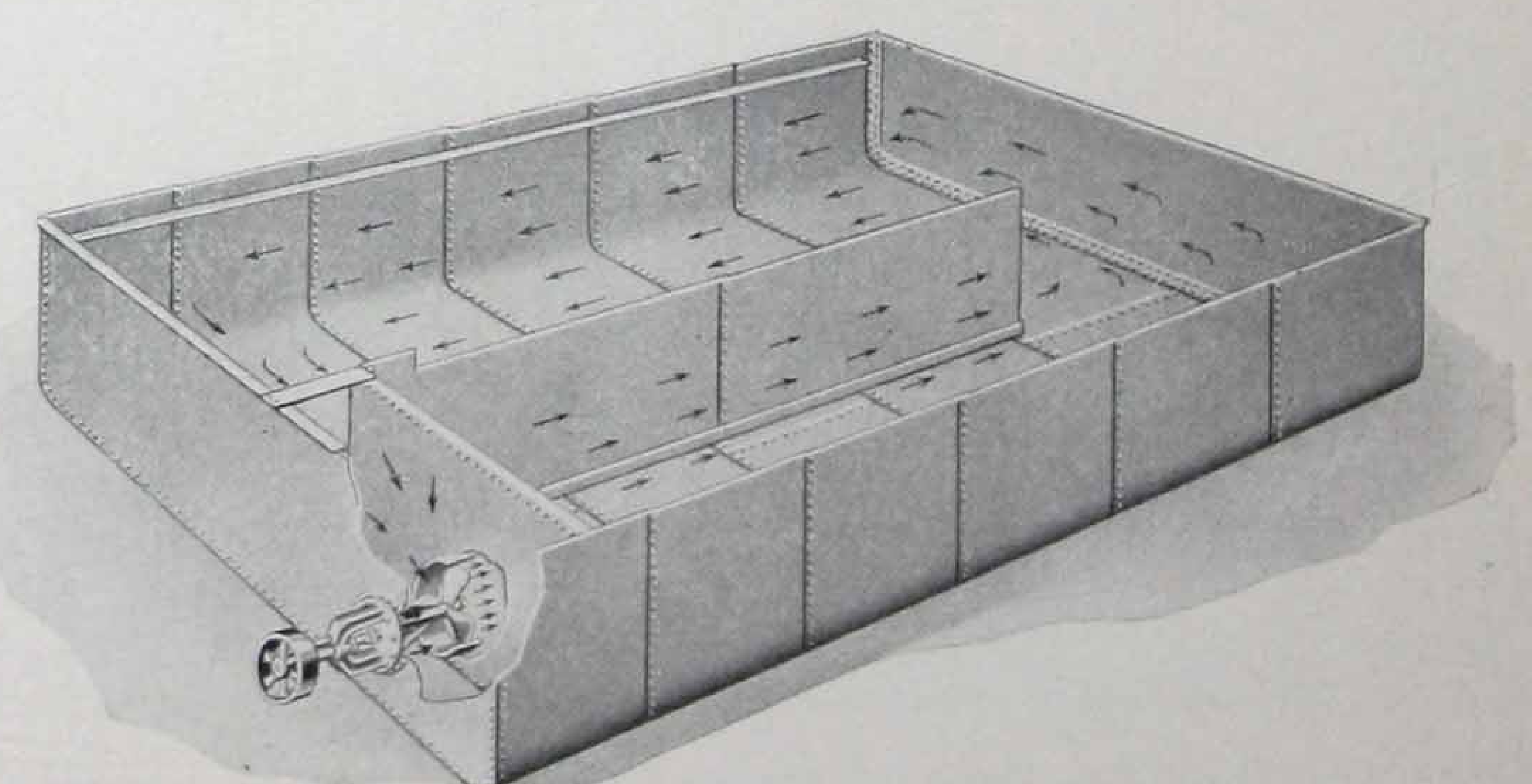


Fig. 18 — Riveted Ice Tank with Bulkhead, Partition, and Agitator.

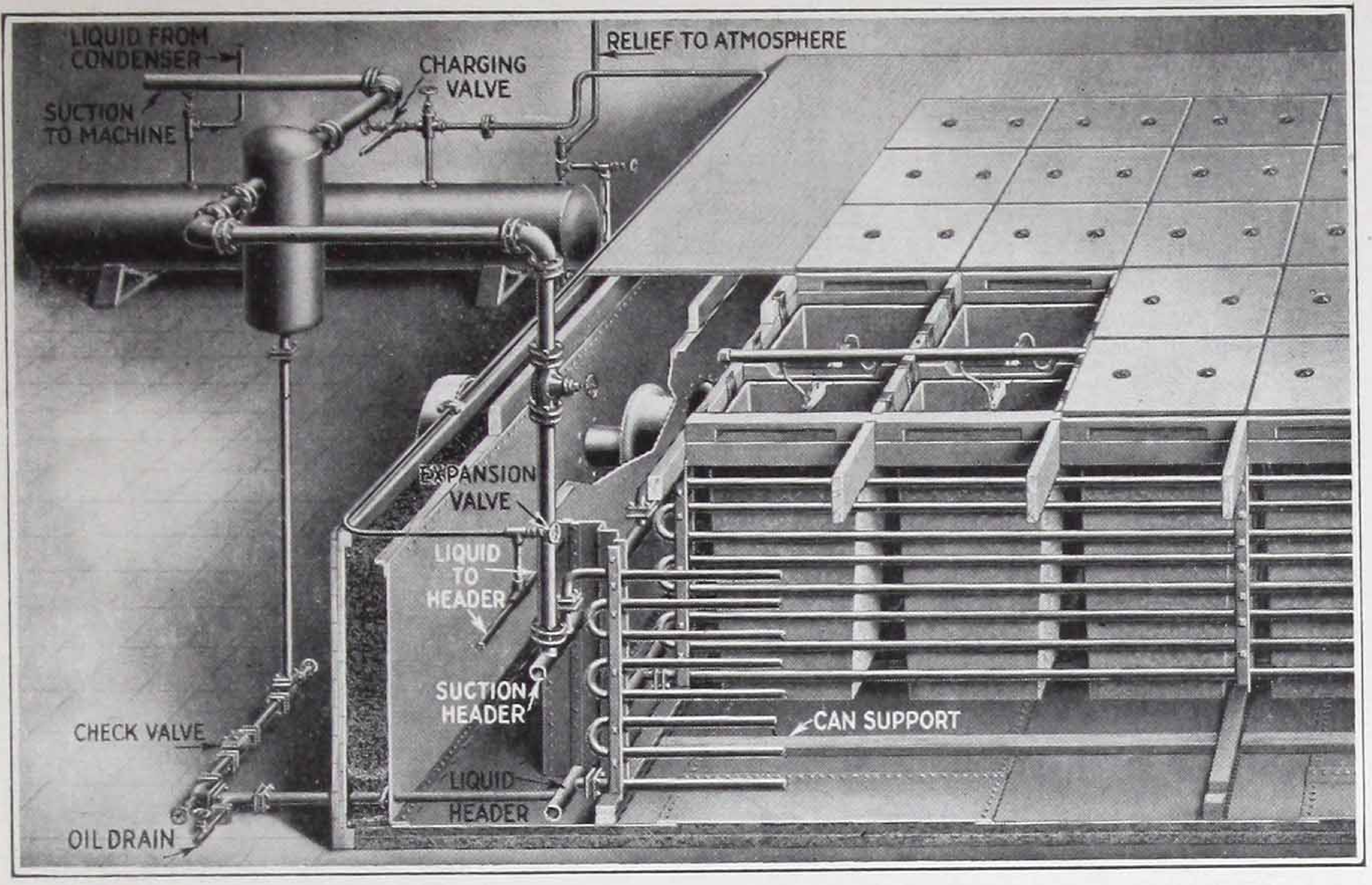


Fig. 19—Cross-section Through an Ice-Making Tank, Showing Arrangement of Coils, Accumulator, Framework, Agitator, Insulation, and other Details.

Ice Cans Are made of heavy galvanized iron, either riveted or, preferably, welded so as to be one piece. They are furnished in a variety of standard sizes and are nested in one another, before shipment.

ALL-WELDED cans have molten zinc sprayed over the seams (no solder), which seams are thicker and stronger than the original metal. The inside seams being flush, the ice slides from this type of can most readily.

Fig. 20 — All-welded Ice Can

Crane and Hoist These are made for hand operation, as illustrated, or with air or electric hoists. The bridge wheels have roller bearings. A heavy I-beam supports the carriage on which the hoist travels. A spiral drum on the gear shaft permits quicker raising of the can while it is partly floated by the brine. (Fig. 21) For small tanks where no crane is needed, a truck hoist is offered. After the can is lifted from the brine, it is carried by the truck hoist to the dump.

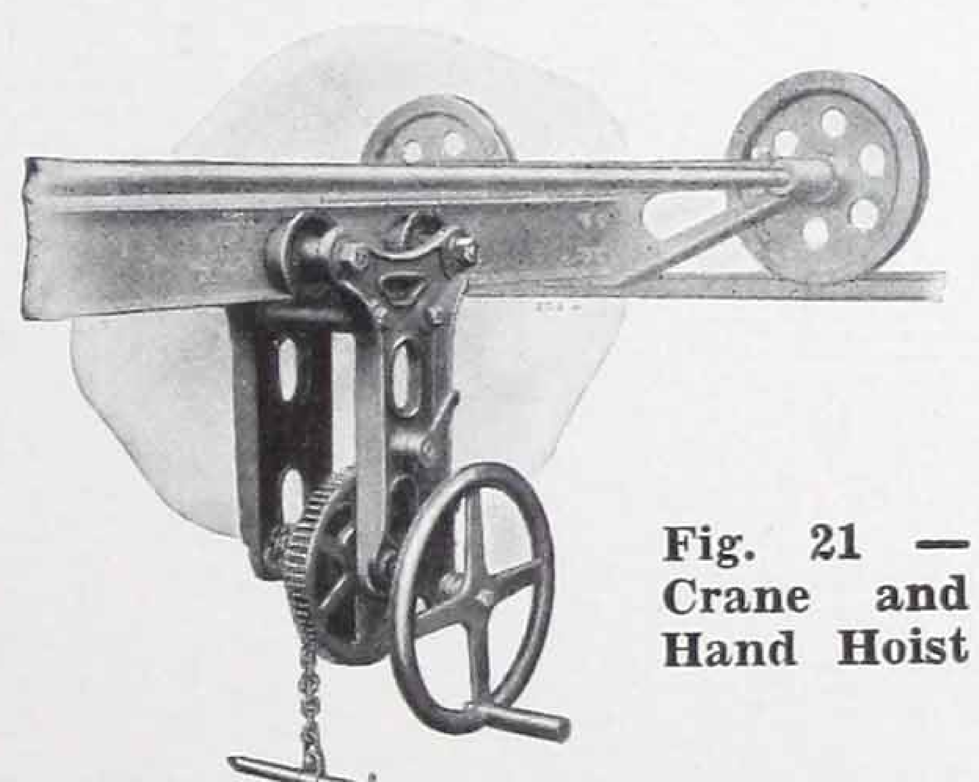


Fig. 21 — Crane and Hand Hoist

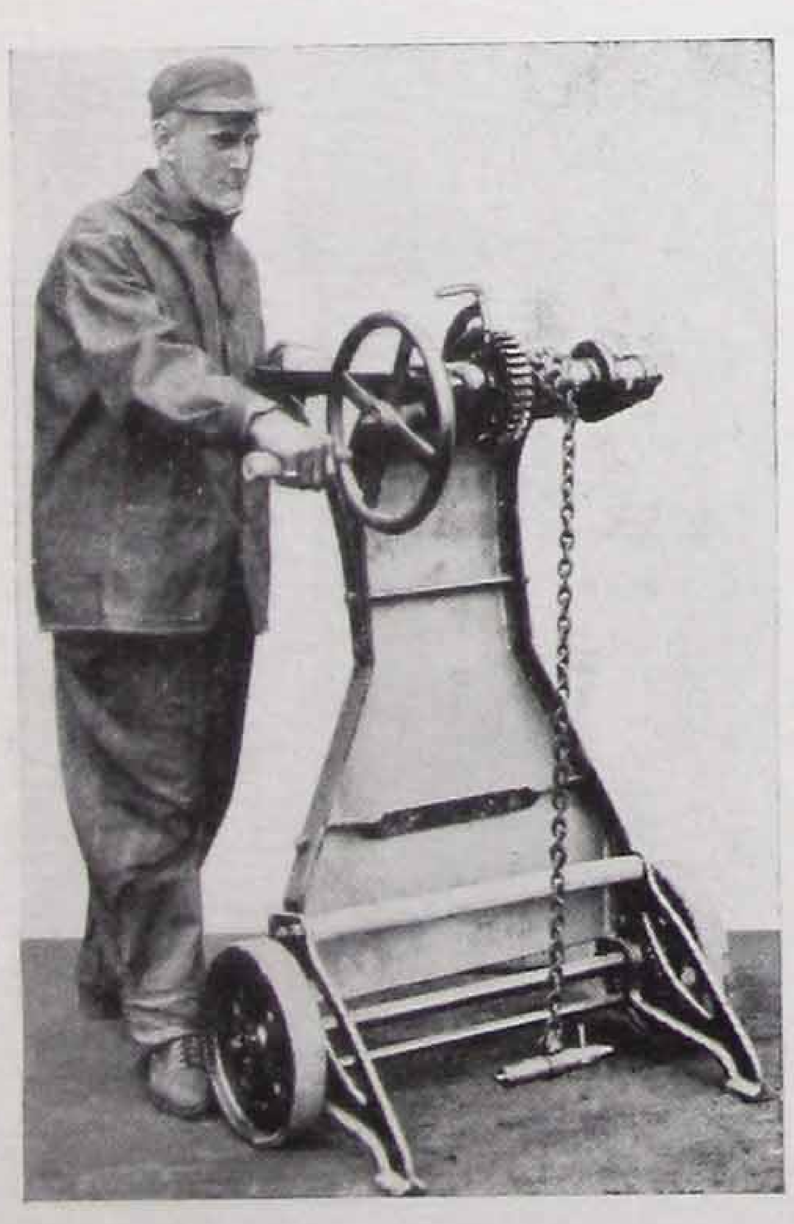


Fig. 22 — Truck Hoist

The smallest cans are handled with can lifting hooks.

The ice-making system in Fig. 26 includes a truck hoist.

Can Dumps Are provided with or without sprinkler pipes for thawing the ice free. Steel drip pans are supplied when ordered. (A dipping tank, filled with warm water, is often used instead of sprinkler pipes.) Can dumps are made of steel with wood lining; they have steel ice slides. Water for sprinkling is automatically turned on when dump is tipped over.

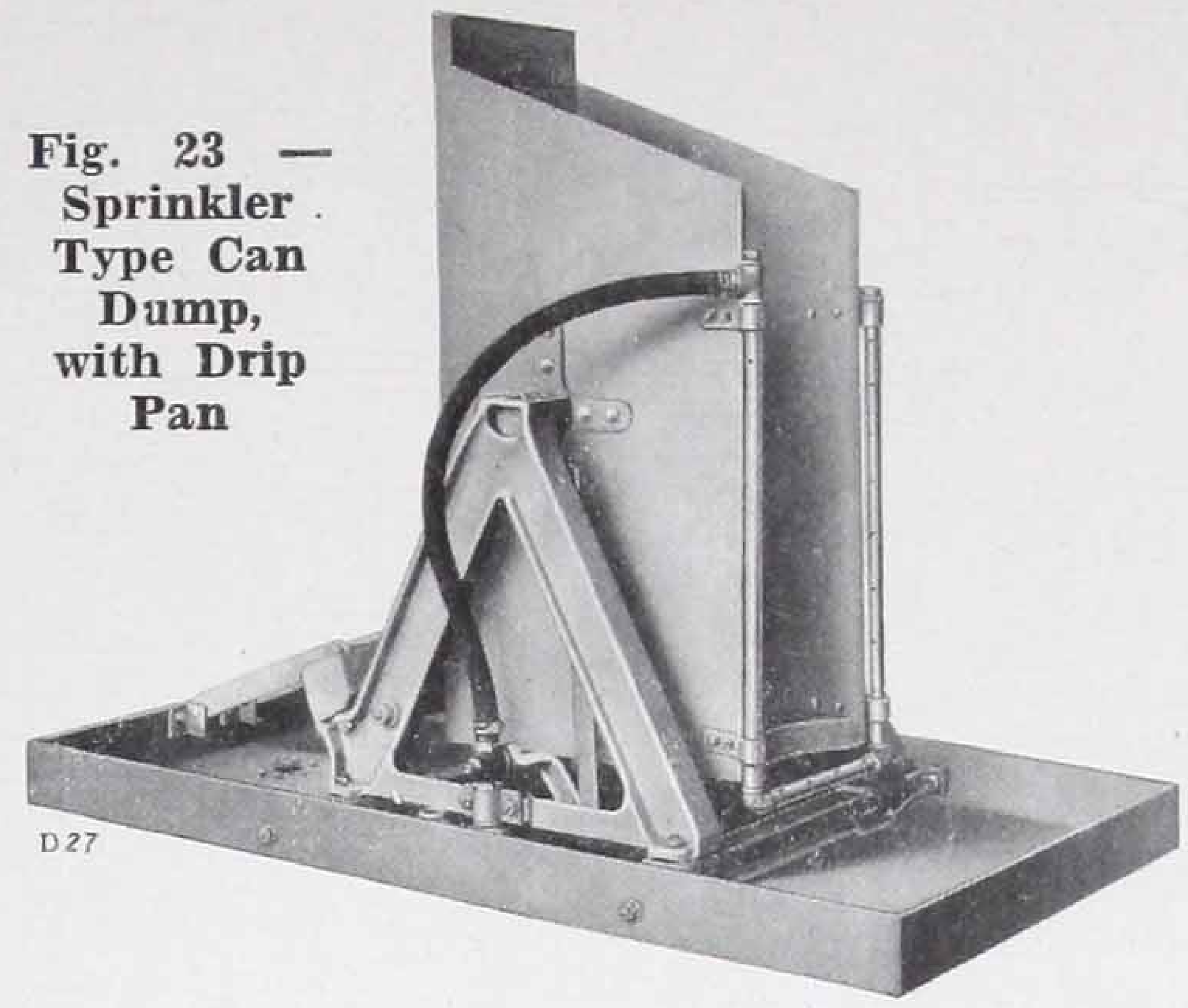


Fig. 23 — Sprinkler Type Can Dump, with Drip Pan

Air Agitation System The blower is of the rotary type and works at only about two pounds pressure; it can be either belted or direct motor driven. A relief valve is supplied with each blower. Arrangements should be made to keep the blower in continuous operation.

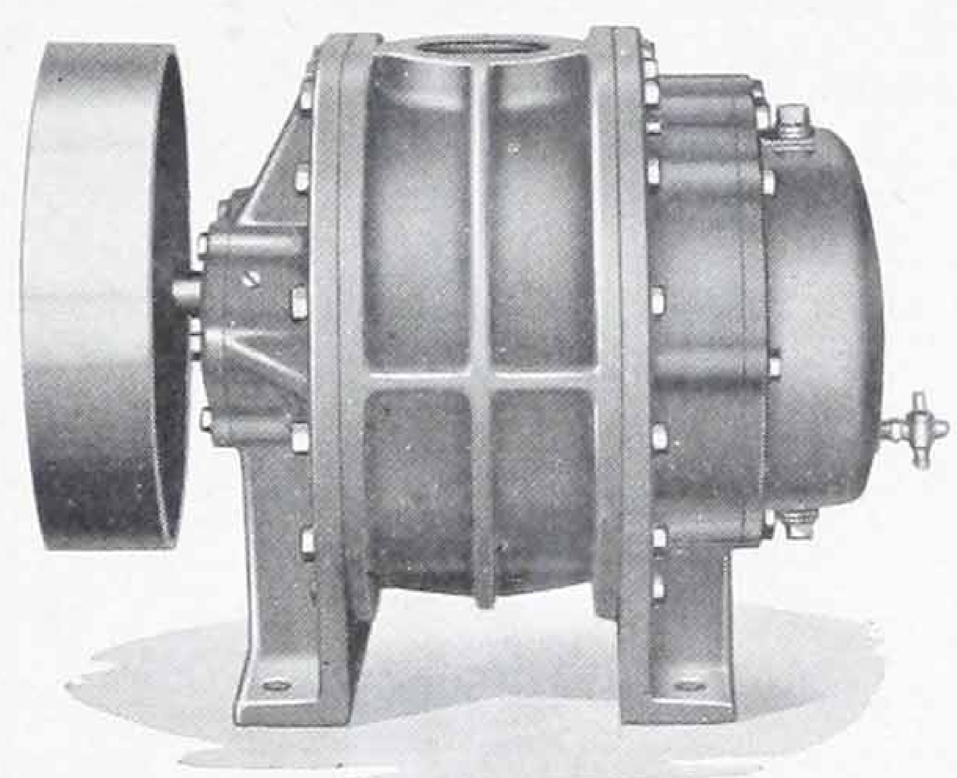


Fig. 24—Air Blower

Can Filler In small plants the can filler, made of brass, is connected to the water line by a long rubber hose. A float valve on the filler shuts off the water in the can at the proper height. For larger tanks a wall-type can filler, located at the

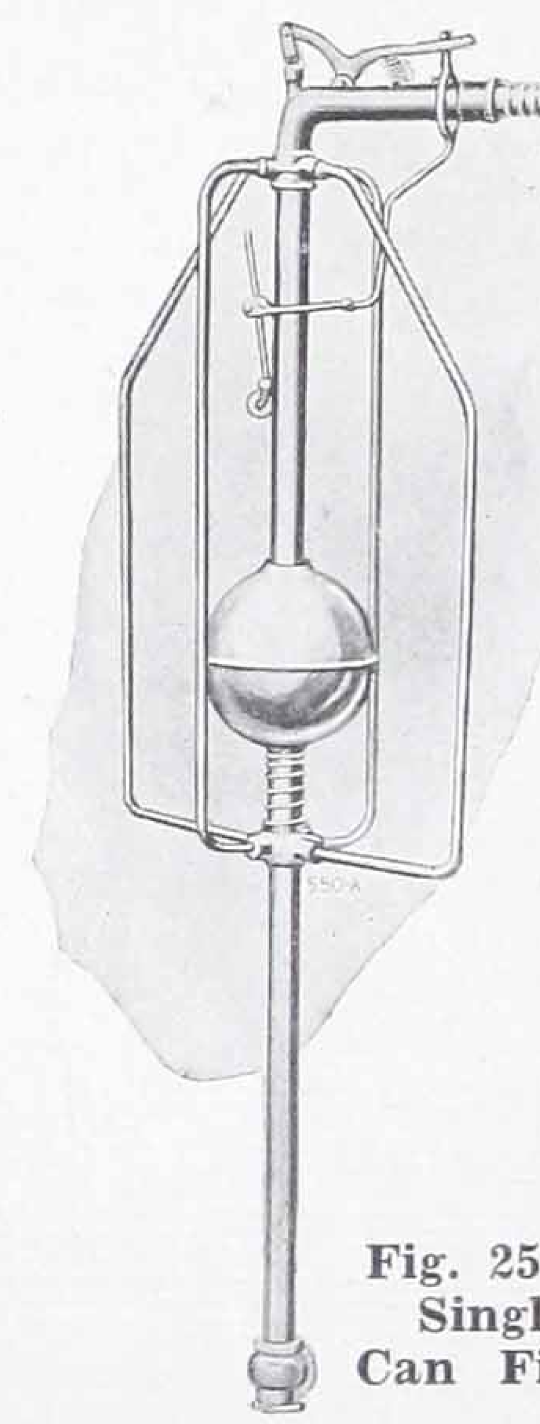


Fig. 25 — Single Can Filler

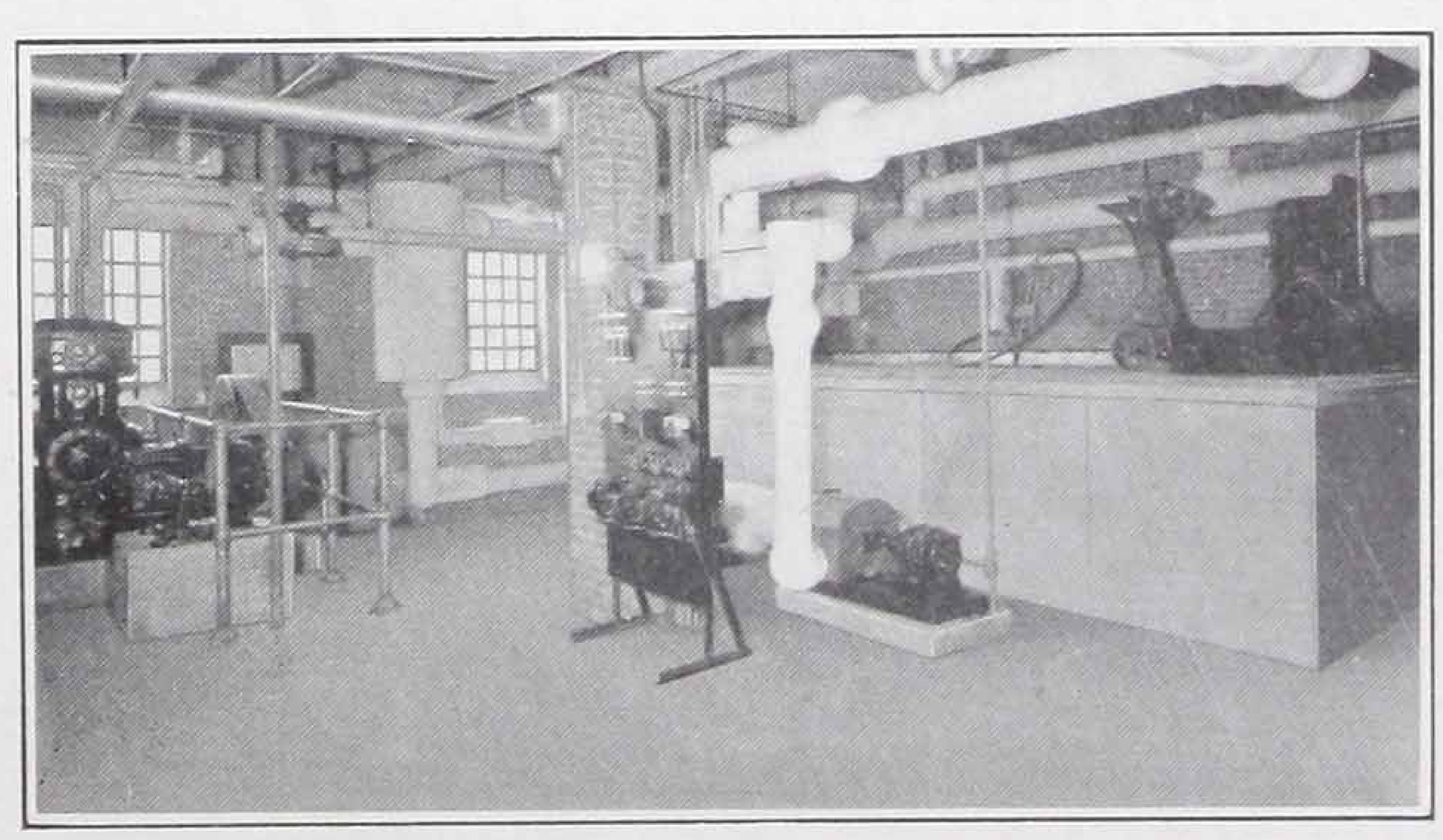


Fig. 26—Small Ice-Making Tank; Part of the Refrigerating System in an Institution

dump, is used. This automatically measures the correct quantity of water for each can: an adjustment on the pressure tank varies the exact amount of water to suit local conditions.

Accumulator The accumulator is a welded vessel containing baffles for separating any liquid from the suction gas. The necessary check valve, shut-off and drain valves, as shown in the large illustration (Fig. 19), go with it. Full-flooded operation depends upon the proper size and location of the accumulator.

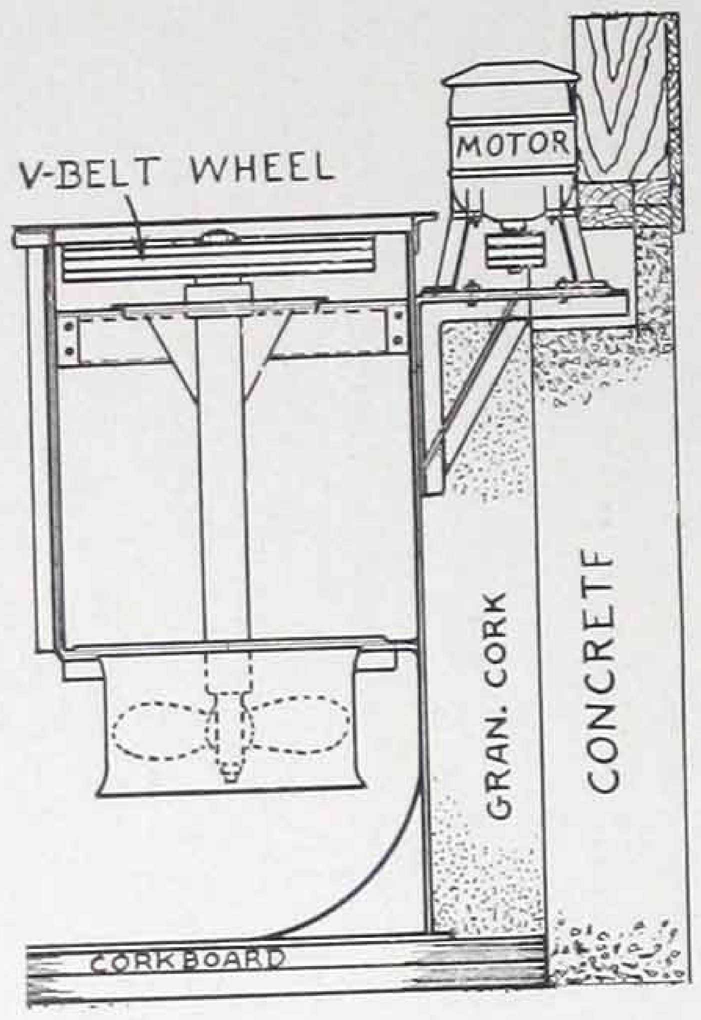


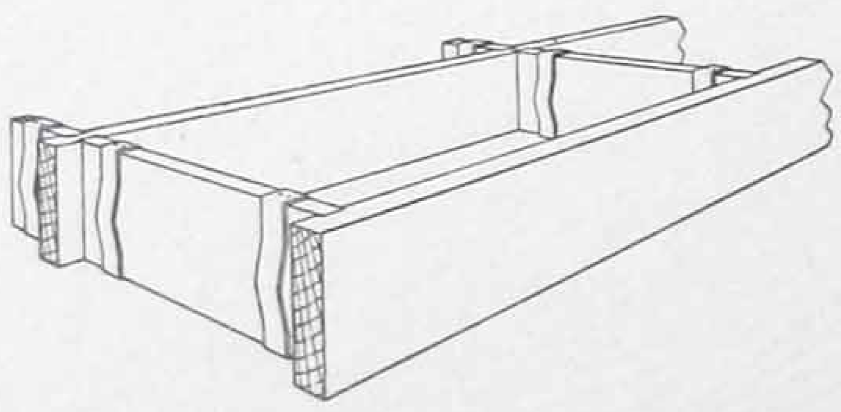
Fig. 27—Vertical Agitator

Tank Coils These are made of $1\frac{1}{4}$-inch selected ammonia pipe, with electrically welded joints, and are tested to 300-lb. air pressure, under water. Gas and liquid headers are included with coils; also supporting stands, bolted on the pipes.

Framework and Covers Are made of stout oak lumber. The frames are slotted to receive the air piping, when used. The can covers have lifting rings secured between the two layers of wood. Each cover is boiled in linseed oil as the best possible means of protecting the wood.

Hold-down Strips Are provided to keep the cans well immersed and in a vertical position. They are made of galvanized spring steel, and are fastened to the cross members of the wood framework, as shown.

Fig. 28—Hold-down Strips in Position on Framework



Partitions The bulkheads and partitions necessary to direct the flow of brine are furnished as shown in the photograph: the agitator hood is fastened to the opening in the bulkhead.

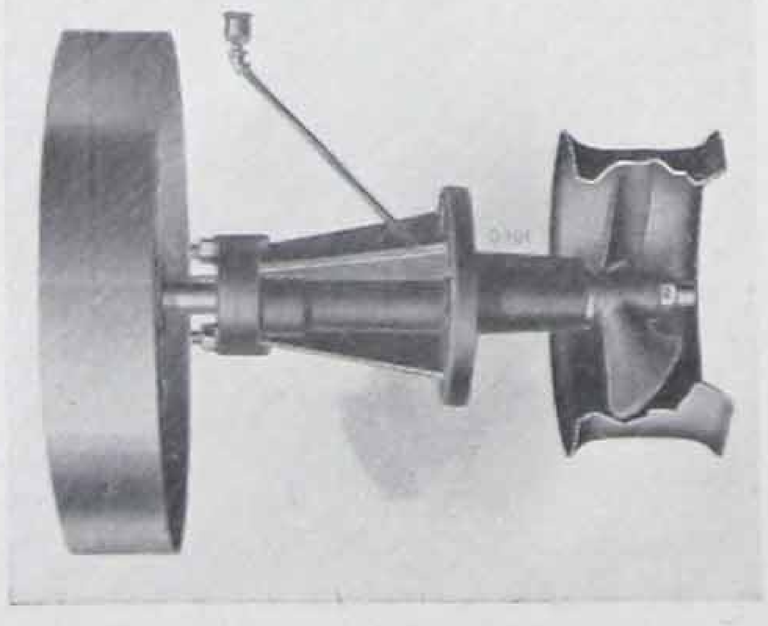


Fig. 29—Horizontal Agitator and Hood or Well Ring

Agitator Horizontal agitators, as used on most ice plants of 1 to 10 tons capacity, are belt driven. Vertical agitators are motor driven. Frick agitators have propeller blades designed for ample circulation of brine with least power consumed.

Brine Race System The tank coils may be combined in a one-piece group known as a Vertiflow Unit evaporator, having lengthwise and cross headers, between which the W-shaped pipes are closely nested by welding. The Vertiflow Unit, as illustrated, is placed in a narrow partitioned space, usually at one end of the tank, the brine being circulated through this "race" at comparatively high velocity. This arrangement is called the Brine Race System: it provides higher heat transfer, together with flooded operation of the evaporator; avoids danger of freezing the brine inside the "tubes" of the cooler; saves erecting labor and space, and has other advantages, particularly in group lift plants, where several cans are harvested at one time. For a full description of Frick group lift equipment, refer to Ice and Frost Bulletin No. 127.

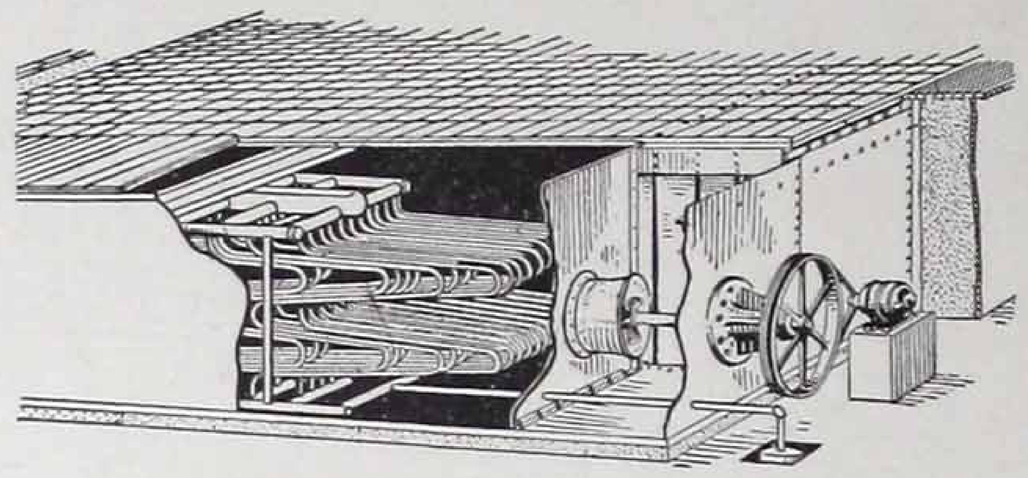


Fig. 30—Arrangement of Vertiflow Unit in Brine Race Tank

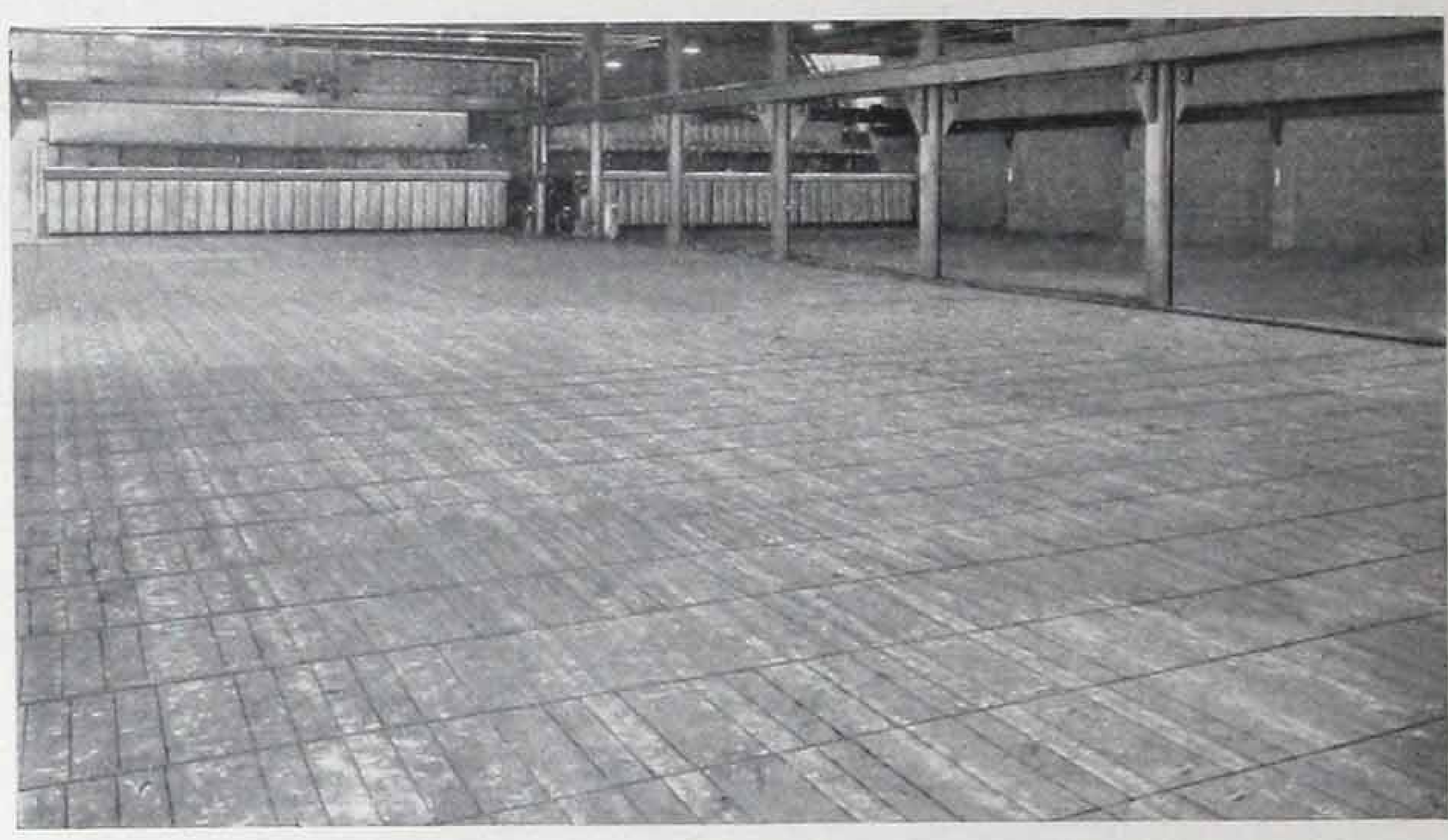


Fig. 31—Group Lift, Using Frick Can Grids, Enables One Man per Shift to Harvest 100 Tons of Ice. One-man Plants, with Automatic Controls, Freeze 40 to 50 Tons of Ice Daily.

The Vertiflow Unit is built to suit the shape and capacity of the tank, and is thoroughly tested before shipment from the Frick Works at Waynesboro.

Where shell-and-tube brine coolers are preferred, we furnish welded vessels of the proper size and containing the necessary tubes for effective operation.

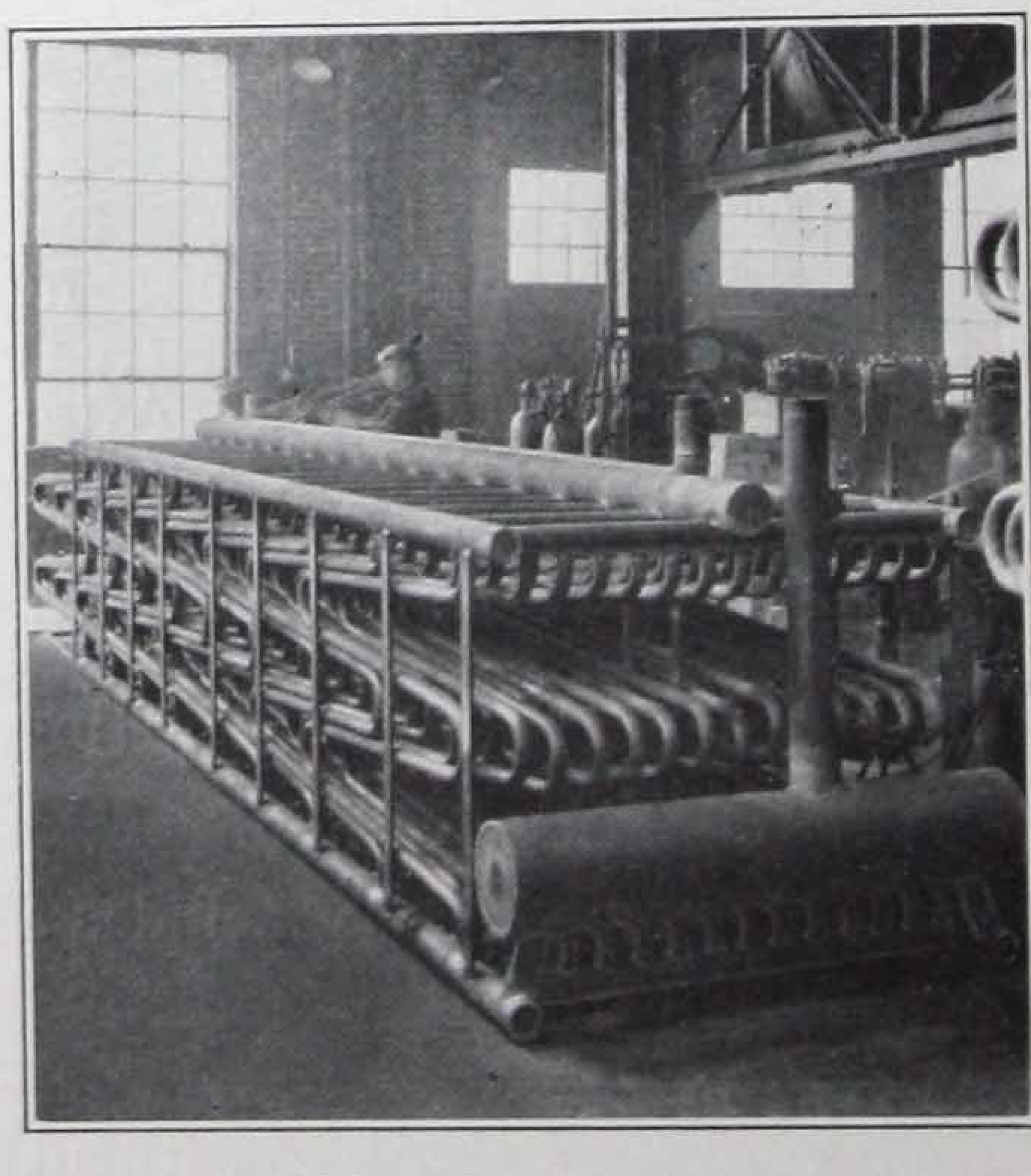


Fig. 32—Vertiflow Unit Coil Being Welded

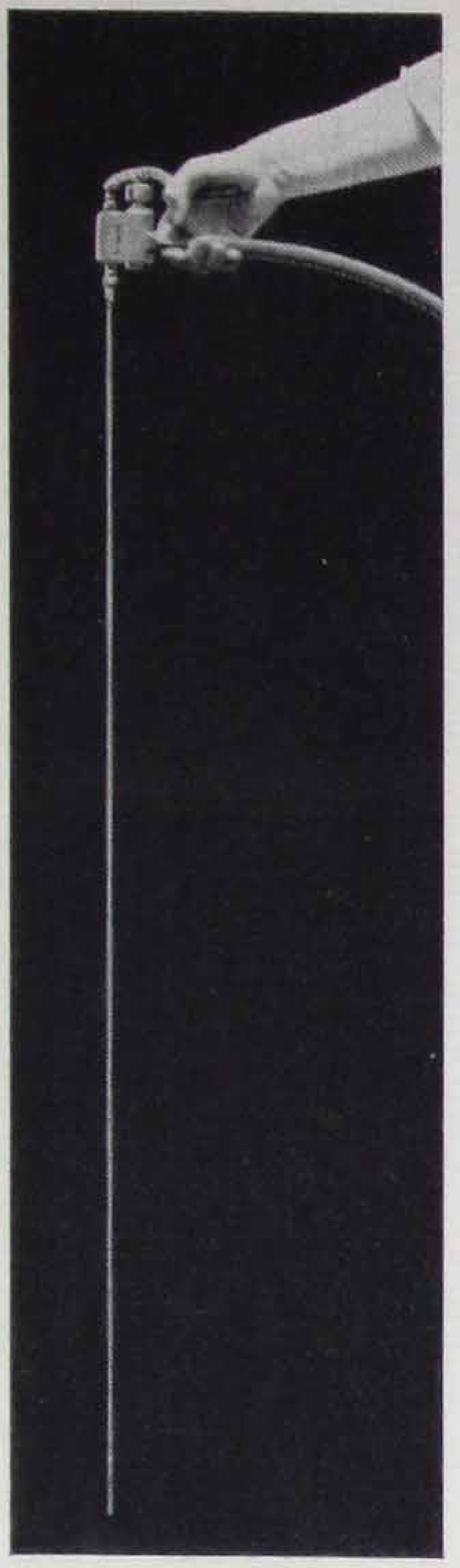


Fig. 33 — Thawing Needle

Drop Pipes and Fittings

The air tubes are of seamless drawn brass, 5/16-inch diameter. Special brass fittings connect the tubes to the air laterals, through a rubber hose.

Air Headers and Laterals

This includes air suction and supply headers on the framework, and galvanized air laterals between the rows of ice cans. The item "air connections" includes the piping from the blower to the headers.

Thawing Needle

To thaw the tubes free from the ice a brass needle, supplied with warm water or steam through a hose and whistle valve, is provided.

Core Sucker and Refiller

The illustration shows the standard core pumping set; belt-driven core pumps are also available. The core sucking and refilling needles are furnished with rubber hose. Water pipe connections for can filter, core sucker and refiller, and thawing needle, are ordered as a separate item.

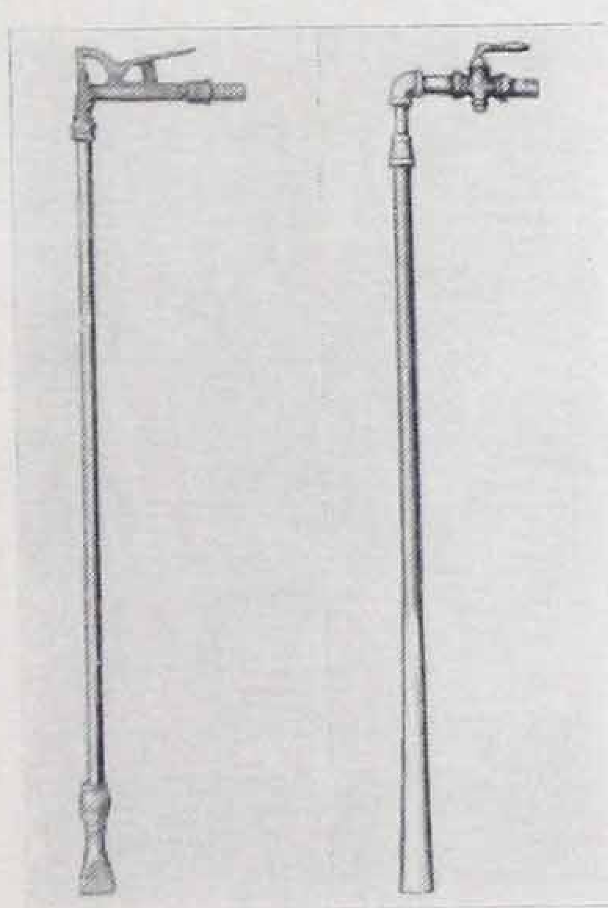


Fig. 35—Core Sucker and Refiller, with Valves

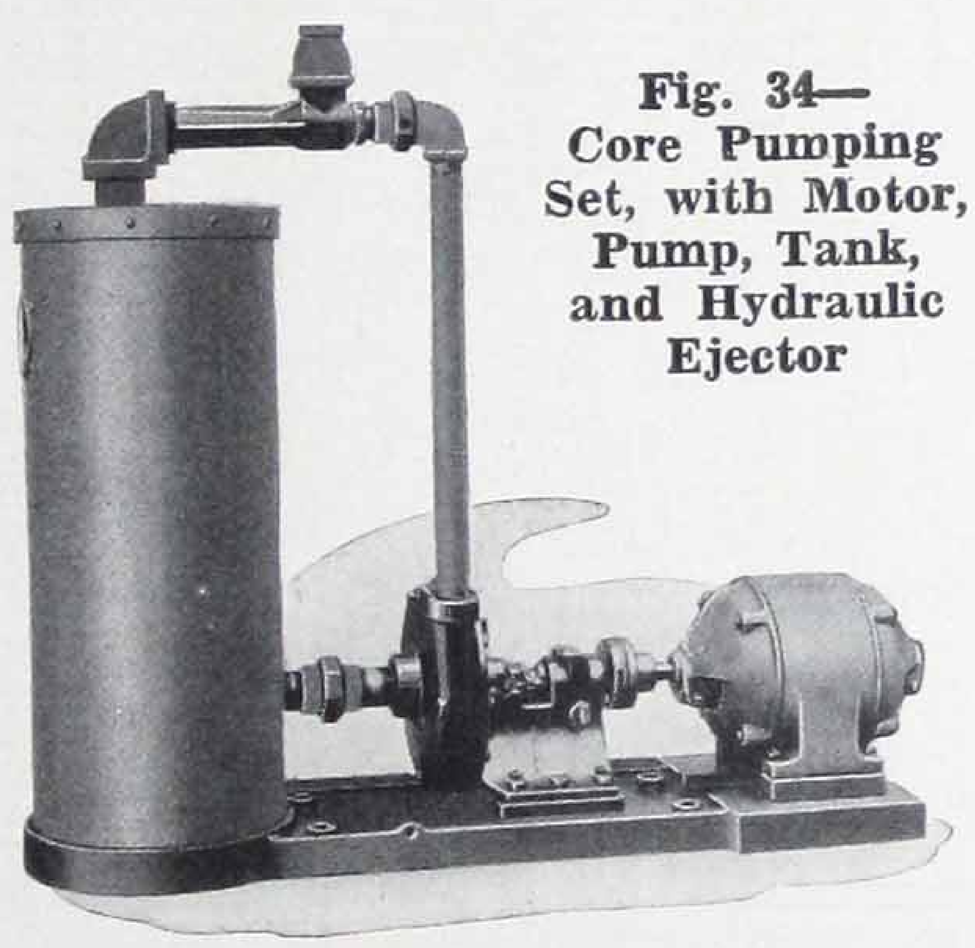


Fig. 34—Core Pumping Set, with Motor, Pump, Tank, and Hydraulic Ejector

Sand Filter

The filter is necessary for clear ice unless the water is very clean. With each filter is furnished an air relief valve, alum feeding tank, pressure gauges, cleaning connections, and the required sand and gravel of large and small size. The can filler and core refiller are to be connected to the water outlet from the filter.

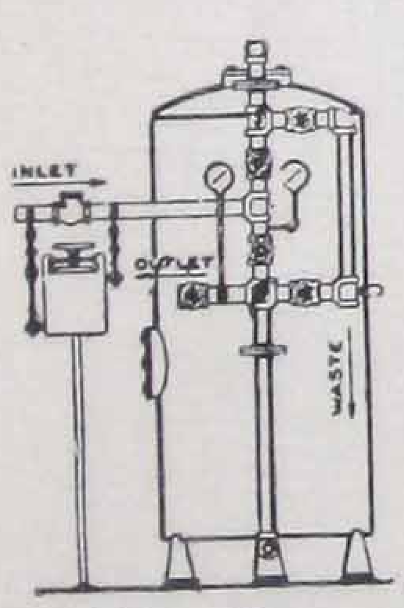


Fig. 36—Sand Filter

Storage Room Coils

Can be supplied for ceiling or walls of ice storage rooms, keeping rooms at desired temperatures. Coils are 1-inch, 1¼-inch, or 2-inch pipe, made up in continuous form by electric welding or with flanges, as ordered. Hangers and supports, with ammonia valves, are sent with coils, to suit the drawings. Coils are designed to hold a temperature below 32° F. in properly insulated ice storage rooms. See Bulletin 156-B for descriptions of all kinds of cooling coils.

Quotations

When writing for quotations, state amount of ice to be made and time plant is to operate per day; also size of ice blocks, dimentions of existing building and storage rooms, and temperature, pressure, and analysis of water, or send a sample of the water and we will have it analyzed, free of charge. Is ice to be clear or opaque? Give details about the power available and all possible information, with sketches, that would help in making an intelligent estimate. Frick Bulletin 127 gives more complete data on ice-making systems.

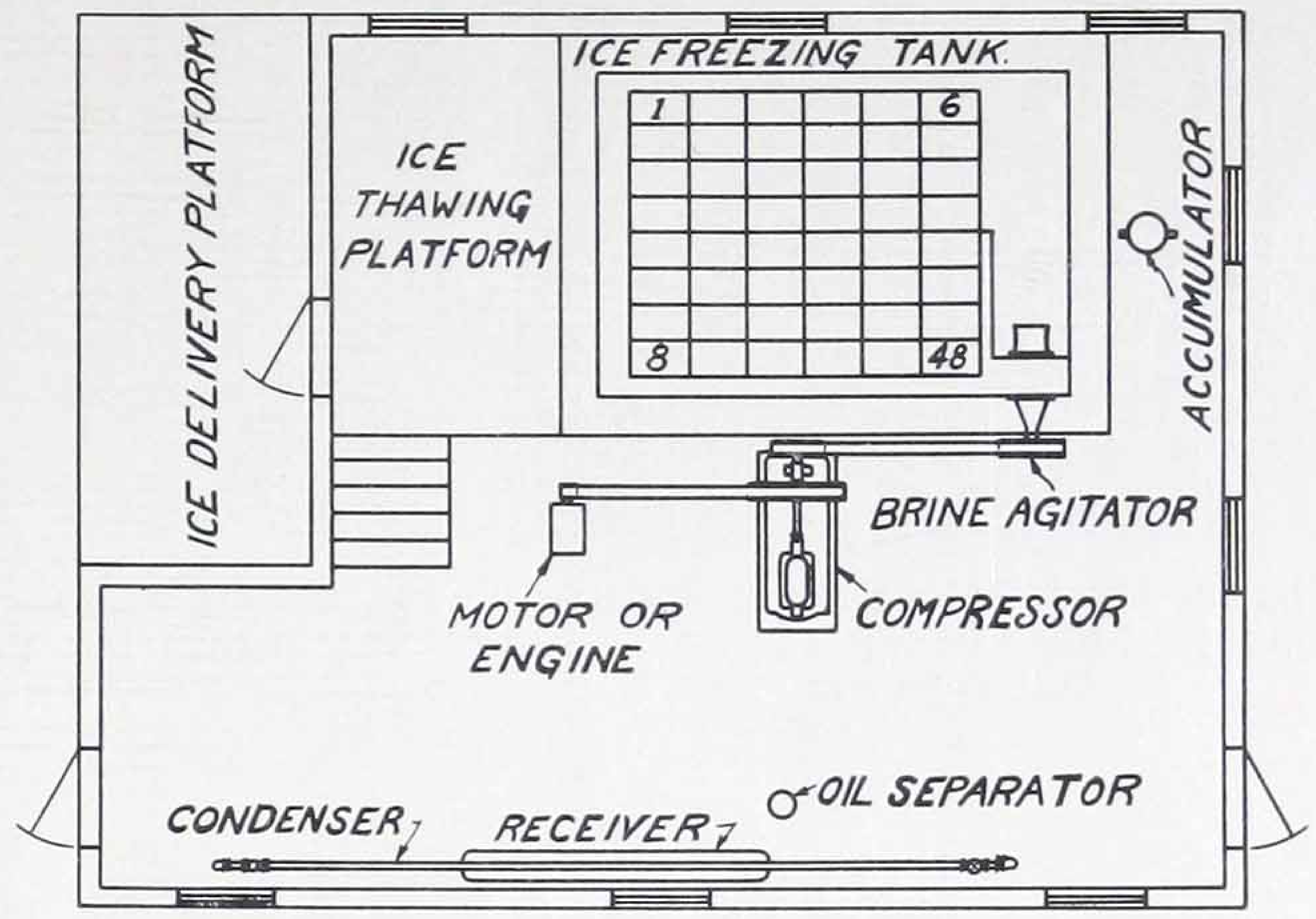


Fig. 37—Layout of Small Ice Plant, without Storage Room

INSIDE DIMENSIONS OF STANDARD ICE FACTORIES

Capacity Tons Ice	Length	Width	No. Cans	Length	Width	No. Cans	Location of 6' Platform
	Using 55-lb. Ice Cans			Using 110-lb. Ice Cans			
1	19'0"	14'6"	20	20'0"	17'0"	24	Outside
2	26'6"	20'0"	40	28'6"	22'0"	48	Included
3	22'0"	22'0"	60	26'0"	26'0"	72	Outside
4	24'0"	24'0"	80	26'0"	26'0"	96	Outside
	Using 110-lb. Ice Cans			Using 300-lb. Ice Cans			
5	30'0"	26'0"	120	34'0"	24'0"	80	Ice Delivery Platform on Outside of Bldg.
6	32'0"	27'0"	144	30'0"	28'0"	96	
7	35'0"	28'0"	163	34'0"	30'0"	108	
8	34'0"	30'0"	192	37'0"	30'0"	120	
9	32'0"	32'0"	216	38'0"	32'0"	140	
10	38'0"	32'0"	240	40'0"	32'0"	154	

Sizes given here are not to be used for constructing buildings: accurate layout drawings are furnished to suit each order.

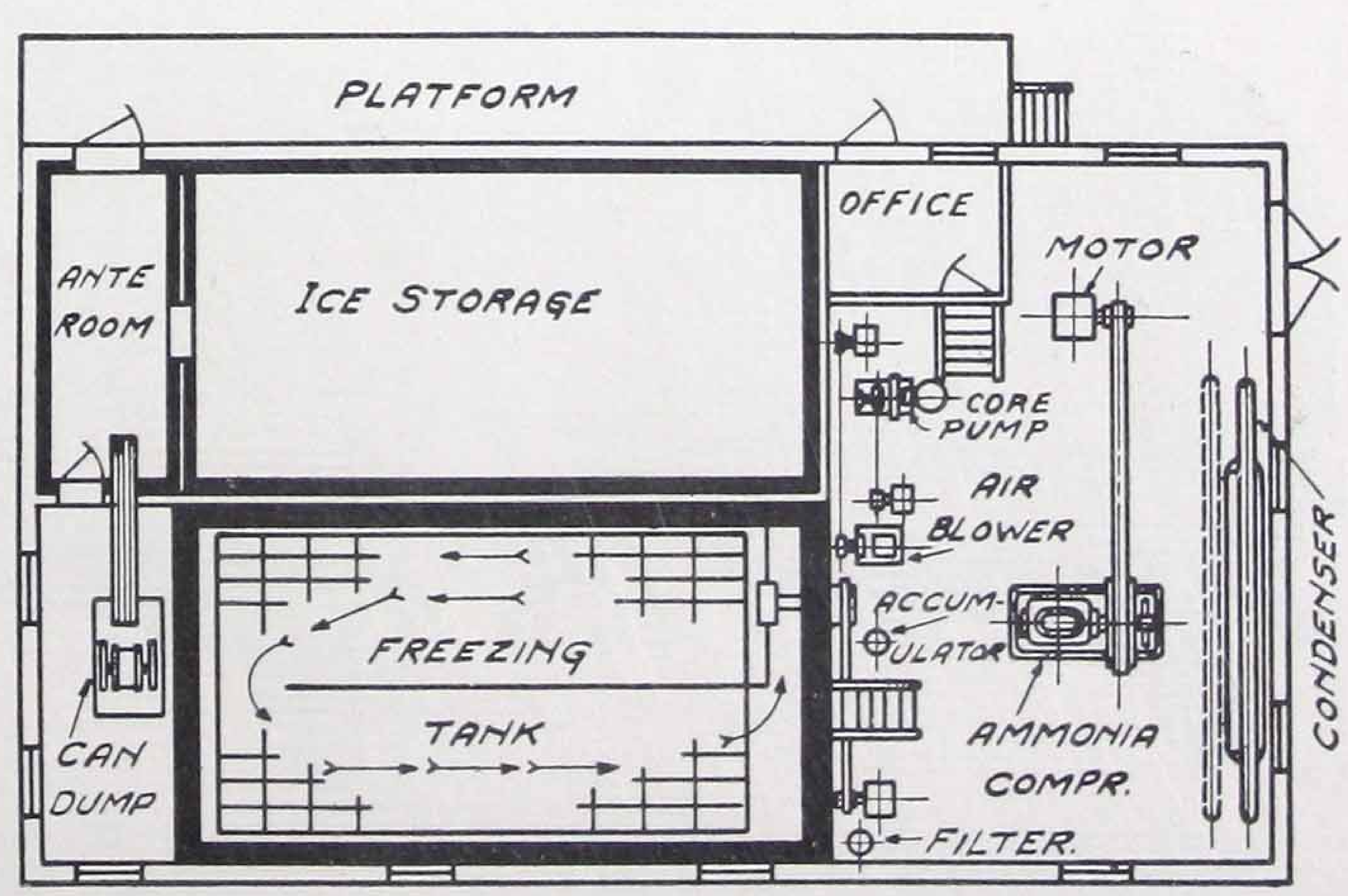


Fig. 38—Standard Ice Factory, 5 to 10 Ton Sizes

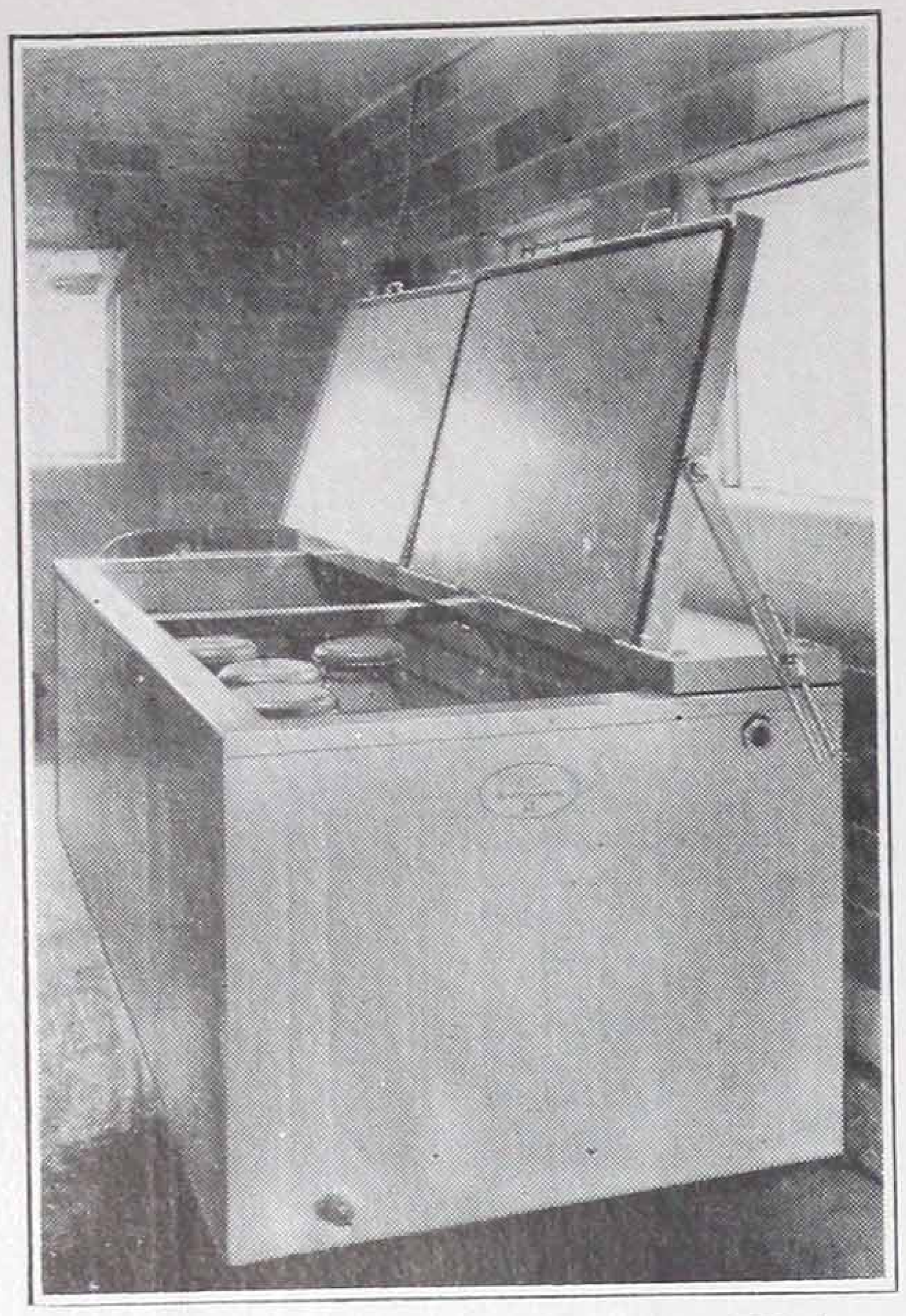


Fig. 39—Frick Units Keep the Water Cold in Milk-Cooling Cabinets on Dairy Farms.

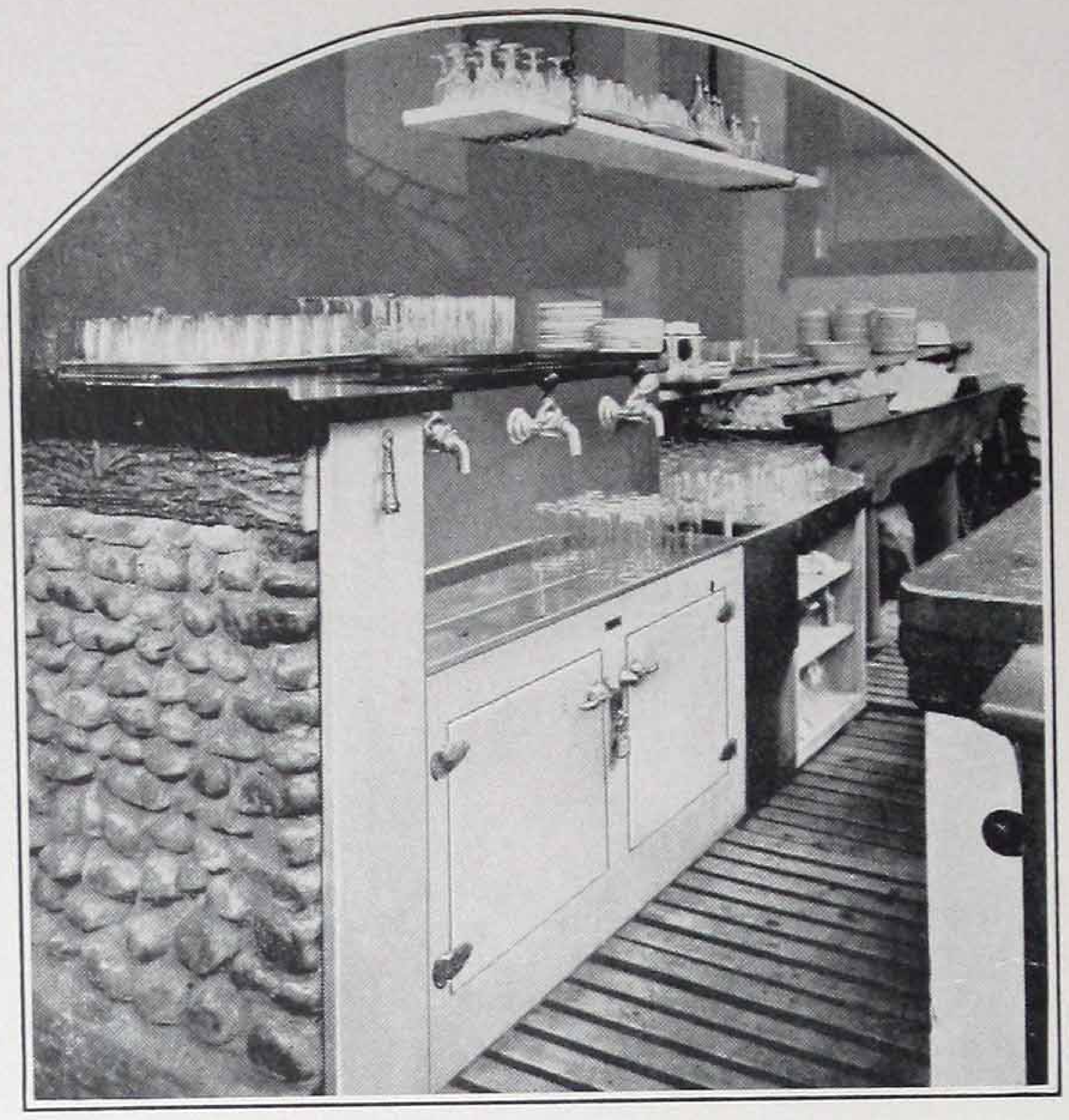


Fig. 40—In Tap Rooms these Units not only Cool the Drinks but Provide Air Conditioning and Refrigeration.

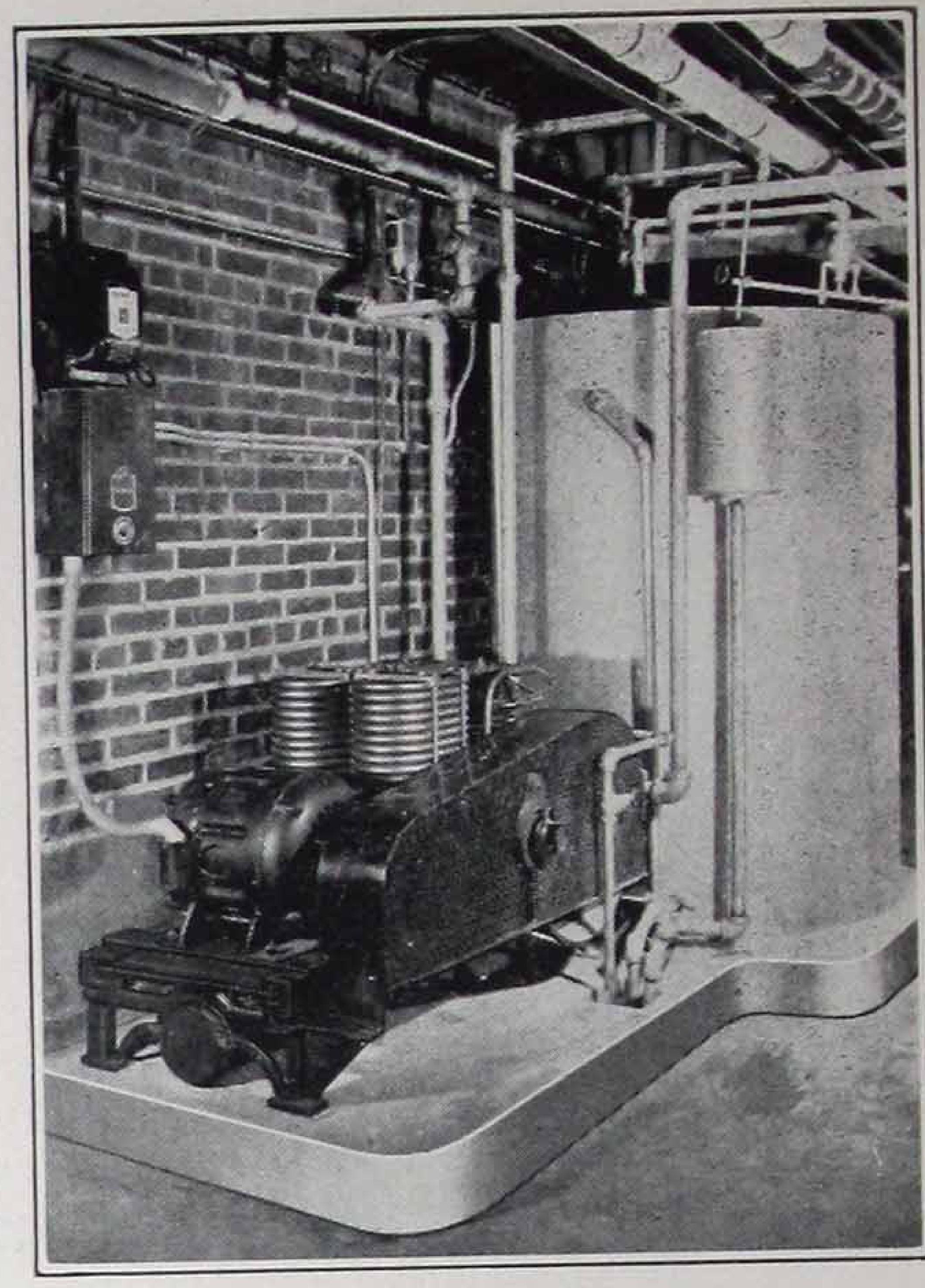


Fig. 43 — Low-Pressure Unit and Tank Supplying Cold Drinking Water in a Factory

Low-Pressure Refrigerating Units

These are built in sizes from ¼ to 15 hp. Each machine is a complete "condensing unit," with the compressor, motor, starter, V-belt drive, condenser, receiver, pipe lines, valves, and control equipment all mounted on a substantial iron base. The smallest machines are air cooled: intermediate sizes have either air cooled or water cooled condensers, as ordered; larger units are water cooled. They are charged with methyl chloride or Freon-12, and are classed for low, standard, or high temperature work, to suit requirements. Capacities vary from a fraction of a ton to 15 tons of refrigeration.

The controls are automatic in operation: they include such magnetic starters, with overload protection, water regulating valves, pressurestats, or others as required for dependable performance. (Thermal expansion valves and thermostats are not considered part of the units.) Cut-outs stop the machines if the head pressure rises to 200 lb. Valve heads are of the safety type, held down by springs. The range and differential of the low-pressure controls are easily set. While compact enough to save valuable space, the machine is at the same time strongly built and accessible, with no parts to be kept in delicate adjustment.

The compressors are of balanced design, with either two or three cylinders, which are honed inside to a mirror finish. Features are the large oil-separating suction chamber with oil-return check valve; high volumetric efficiency; removable plate contain-

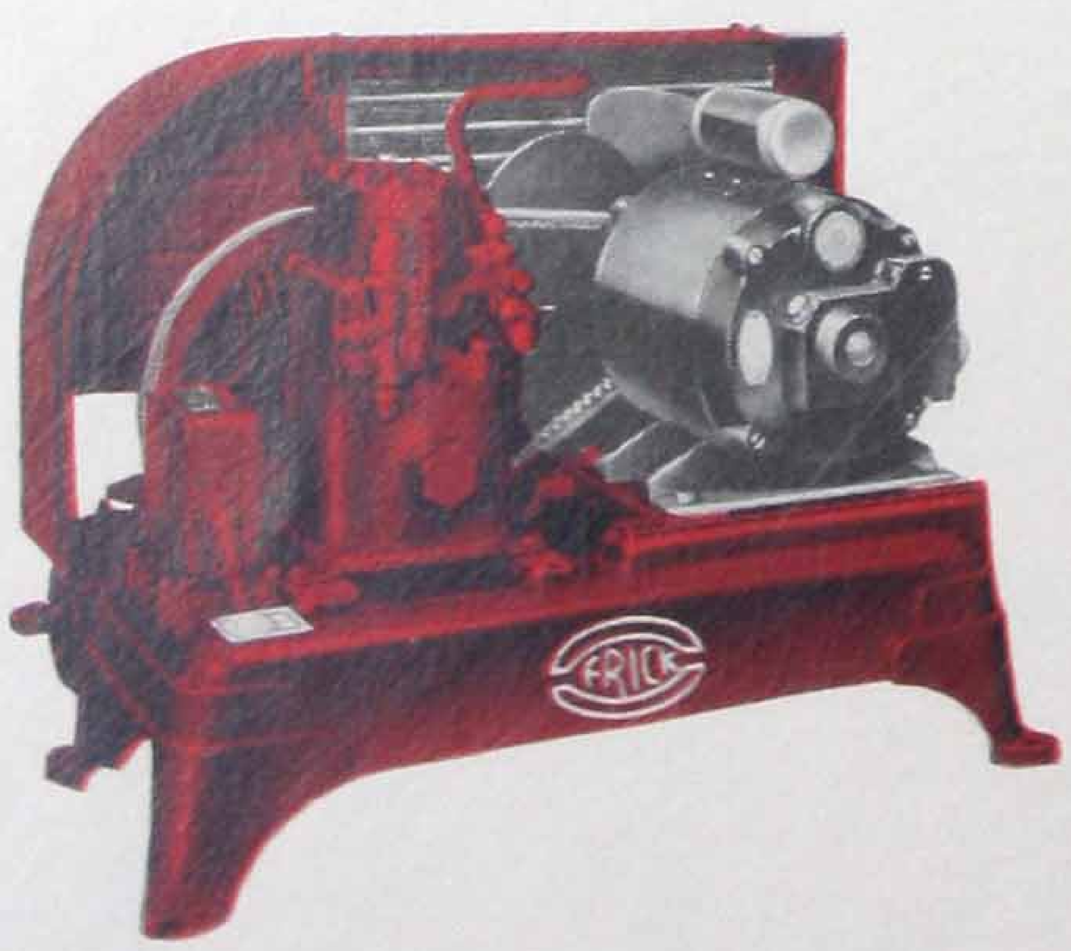


Fig. 41 — Unit of ¼ to ¾ Hp., Air Cooled, Showing Compact yet Accessible Design.

Fig. 42—1 Hp. to 3 Hp. Units, as Equipped with Air Cooled Condensers and Fans.

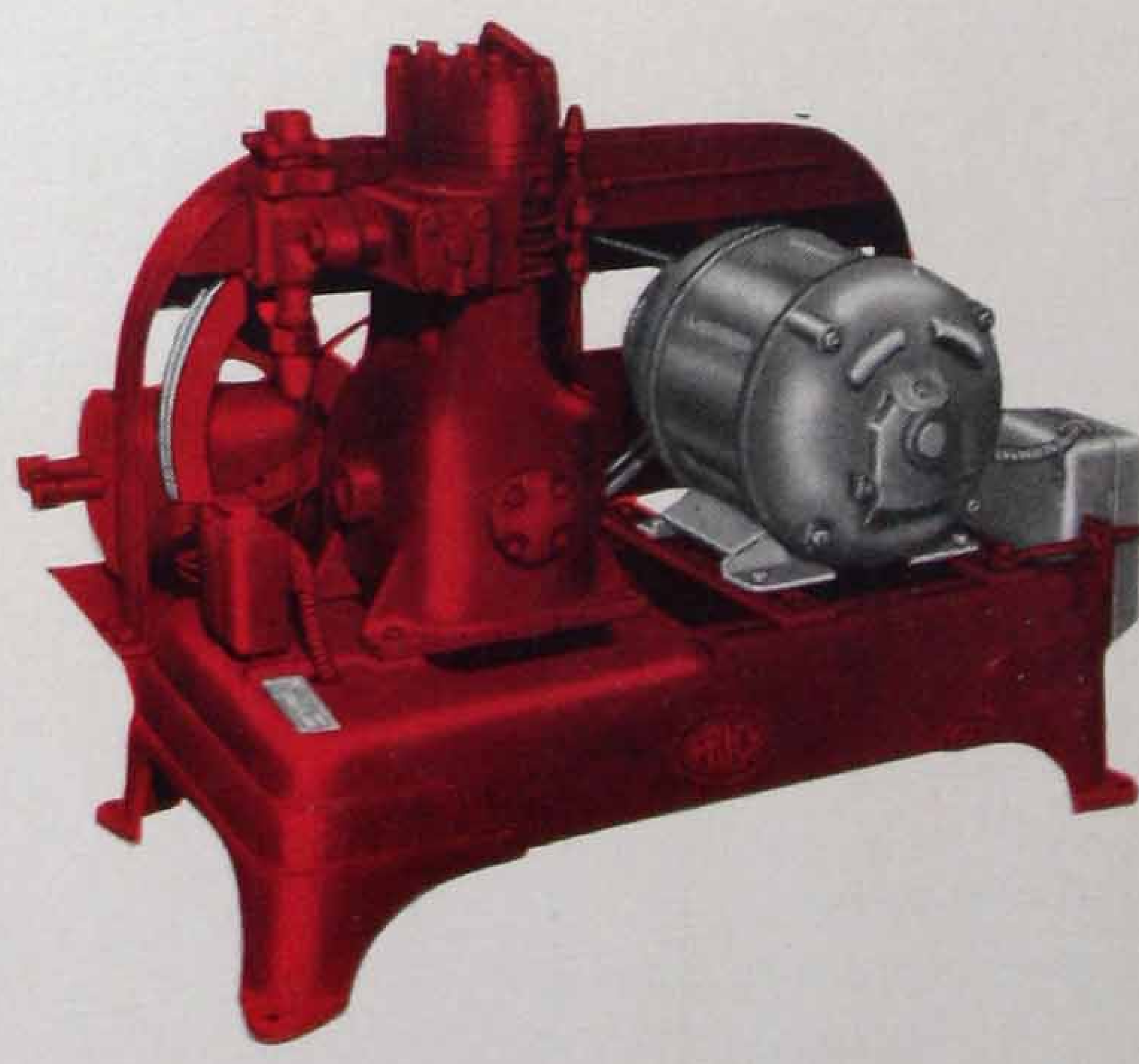


Fig. 44—1, 1½ & 2 Hp. Units Arranged with Water Cooled Condensers.

Fig. 45 — Market and Grocery Stores Cool Boxes and Display Cases Economically with these Units.

Fig. 46 (Left) — This Fish Bar and Restaurant in Chicago is Typical of those Using Frick Units for Cooling Refrigerators and for Air Conditioning.

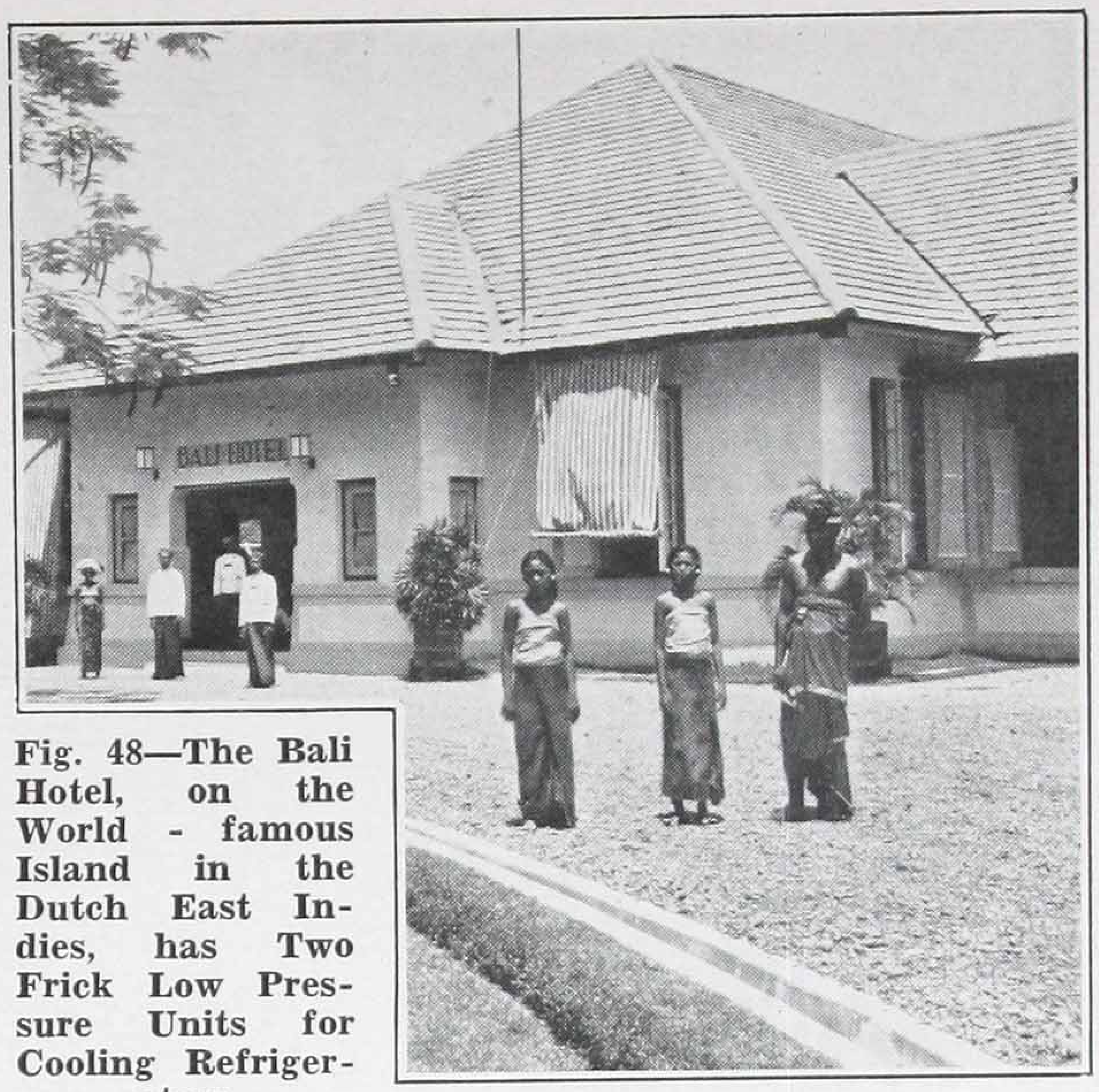


Fig. 48—The Bali Hotel, on the World-famous Island in the Dutch East Indies, has Two Frick Low Pressure Units for Cooling Refrigerators.

Low-Pressure Refrigerating Units

ing both suction and discharge valves; force-feed lubrication on larger sizes; chrome-nickel iron pistons, connecting rod bearings both simultaneously diamond bored; counter-balanced shaft; and shaft seal of patented bellows-and-lubricated-ring design.

Air-cooled condensers are of continuous copper finned tubes, tin-dipped and shrouded to promote the flow of air by the fan, which is on the end of the motor shaft. The water-cooled condensers on small and medium sized machines are made with welded steel shells containing finned copper coils, through which the water flows. Larger machines have shell-and-tube condensers with removable heads. Water regulating valves are of the packless type, pressure operated. Receivers are of seamless steel, and are fitted with fusible plugs: safety valves are supplied on the 5-hp. and larger sizes.

Motor and drives are very quiet-running. Single-phase A. C. motors are the repulsion-induction type; polyphase A. C. are squirrel-cage type; D. C., compound-wound. All compressors are given a thorough run-in test: capacity, quietness, and power tests are rigid, insuring long years of good service. Units are dried out by baking three hours at 210 deg. F. under a vacuum of 27½ in.; are then charged with methyl chloride or Freon-12. (Larger sizes have just enough refrigerant to create a pressure.) The finish is waterproof Frick maroon enamel. Ask for a copy of Bulletin 97.

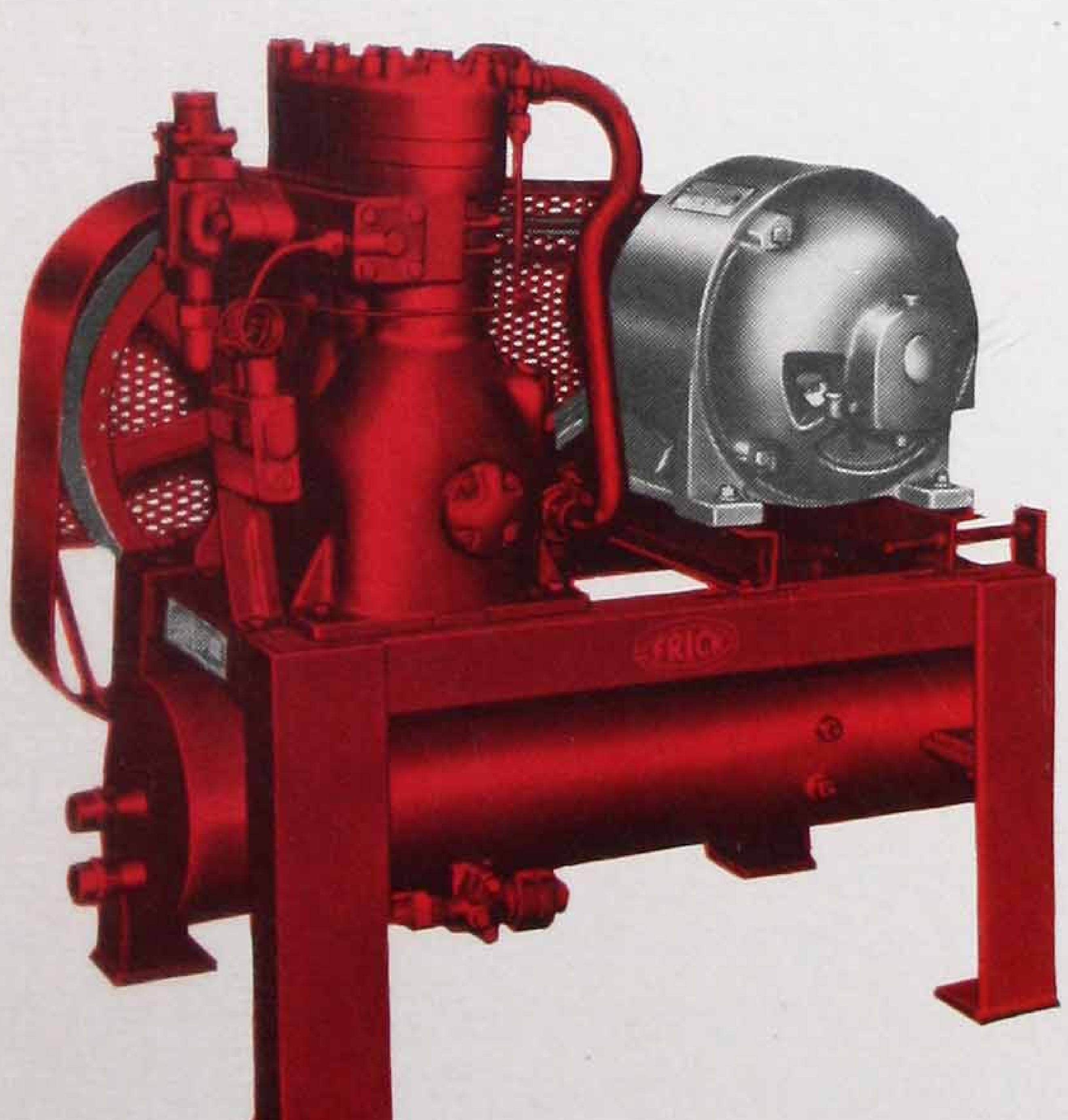


Fig. 47 — Water-cooled Units of 3 to 5 Hp. Sizes Have Three-Cylinder Compressors and This Design.

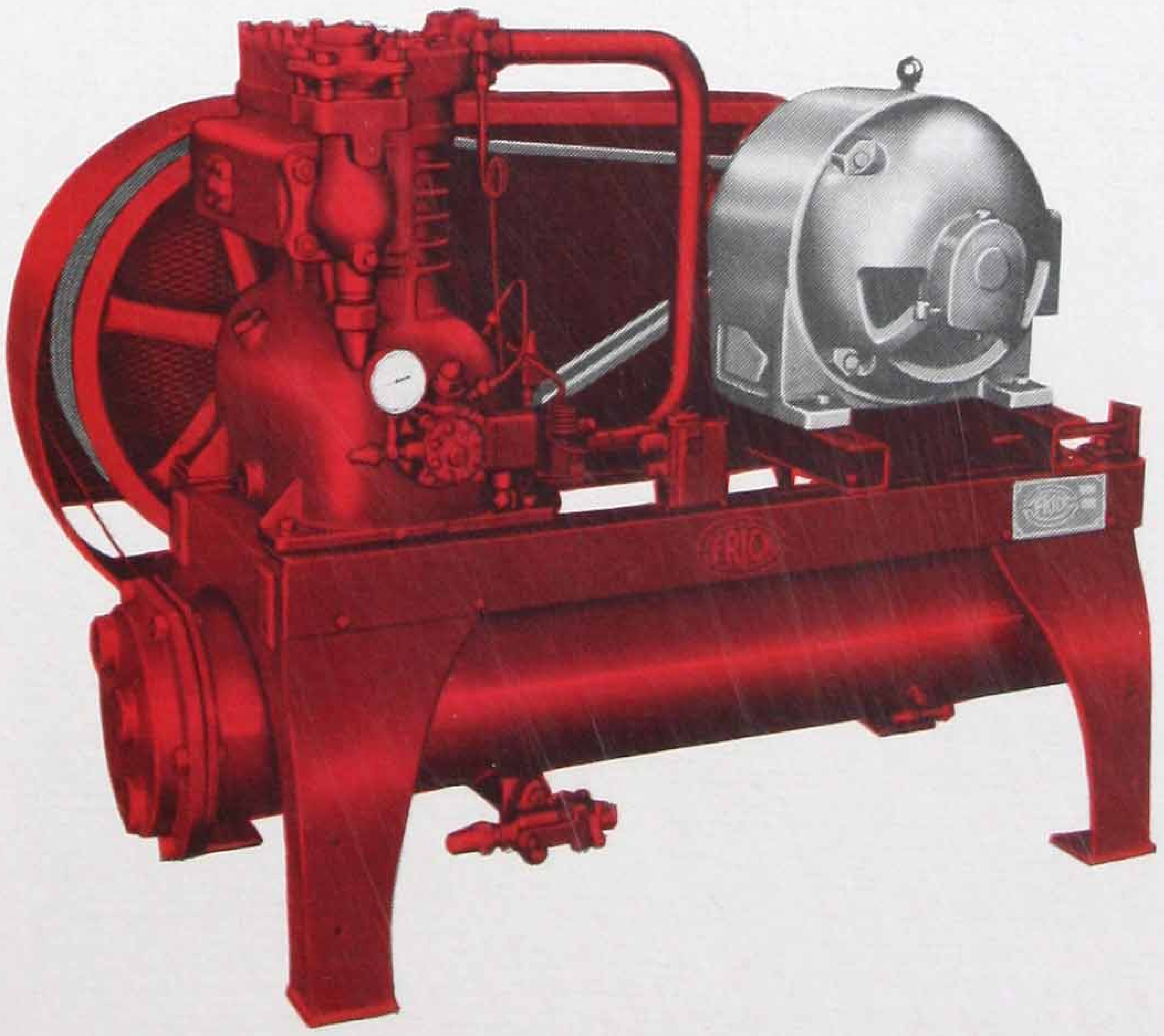


Fig. 49—7½, 10 and 15 Hp. Units Have Shell-and-Tube Condensers and Force-feed Lubrication.

Fig. 50—A Battery of Six "Eclipse" Machines Serves the New 1000-Room Statler Hotel in Washington, D. C.

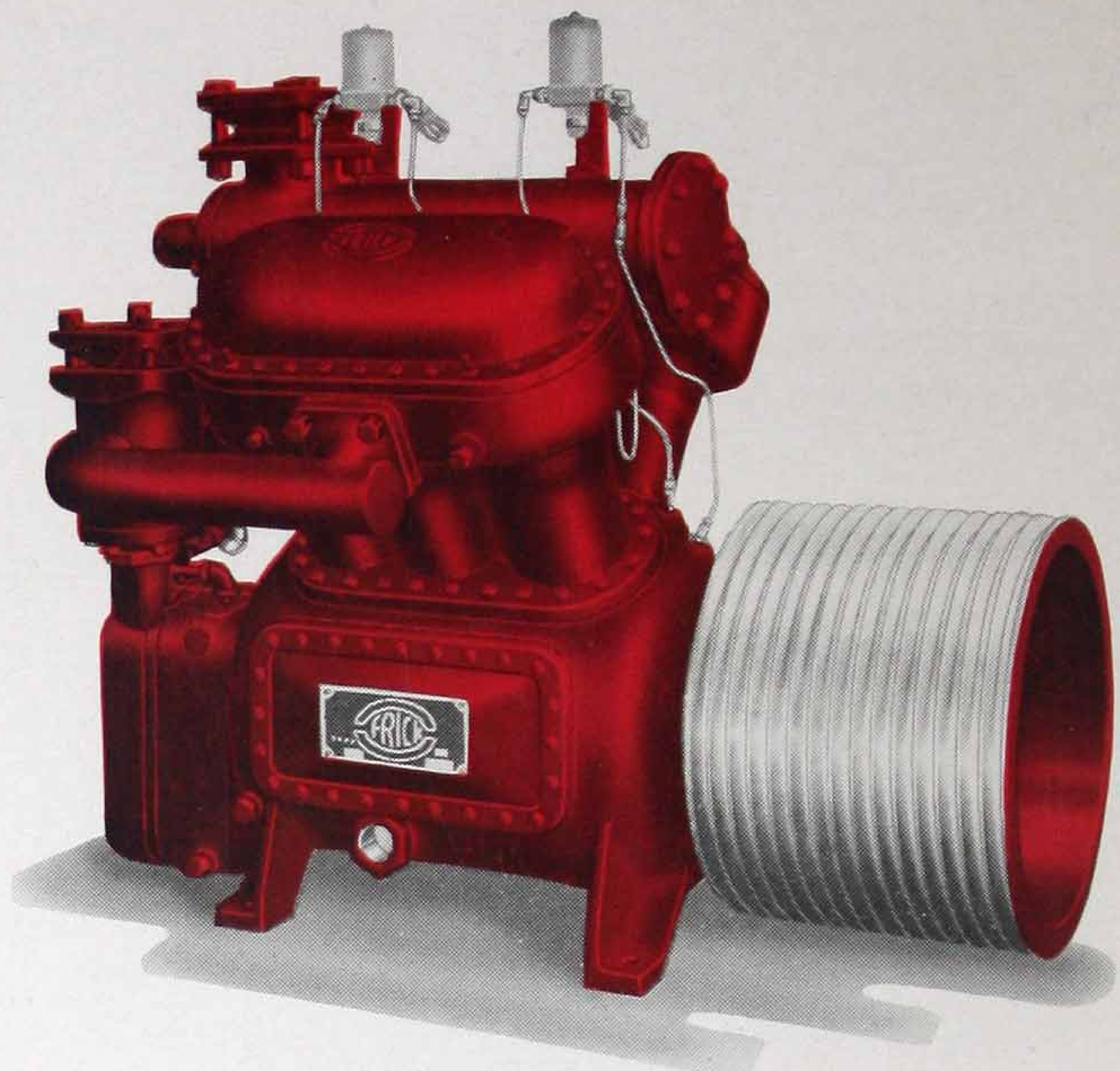


Fig. 53—Four- and Six-cylinder Eclipse Compressors have this V Design. Capacity Controls at Top; Discharge Connection at Left.

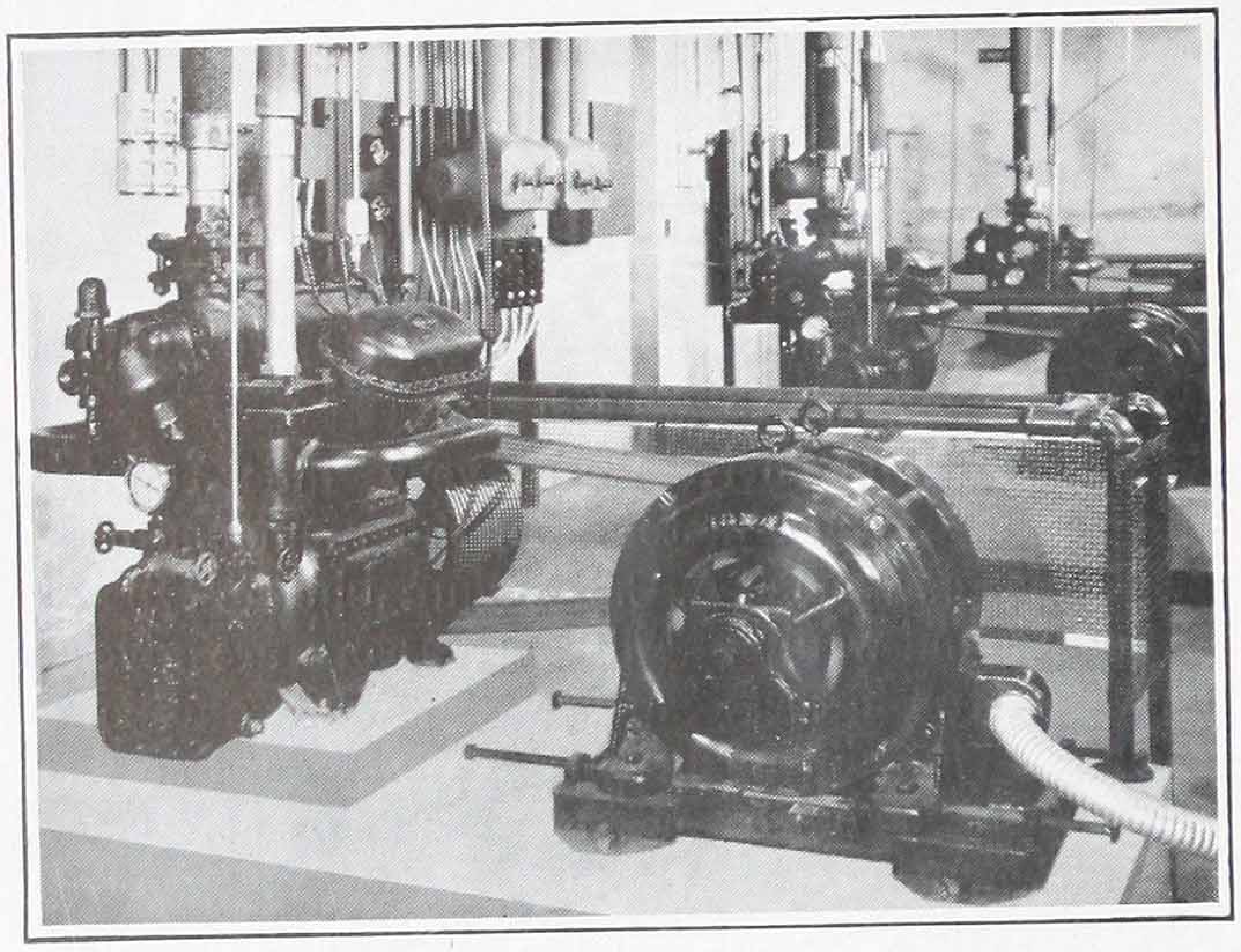


Fig. 51—Three "Eclipse" Compressors in Service at an Army Camp: One Among Many Such Installations.

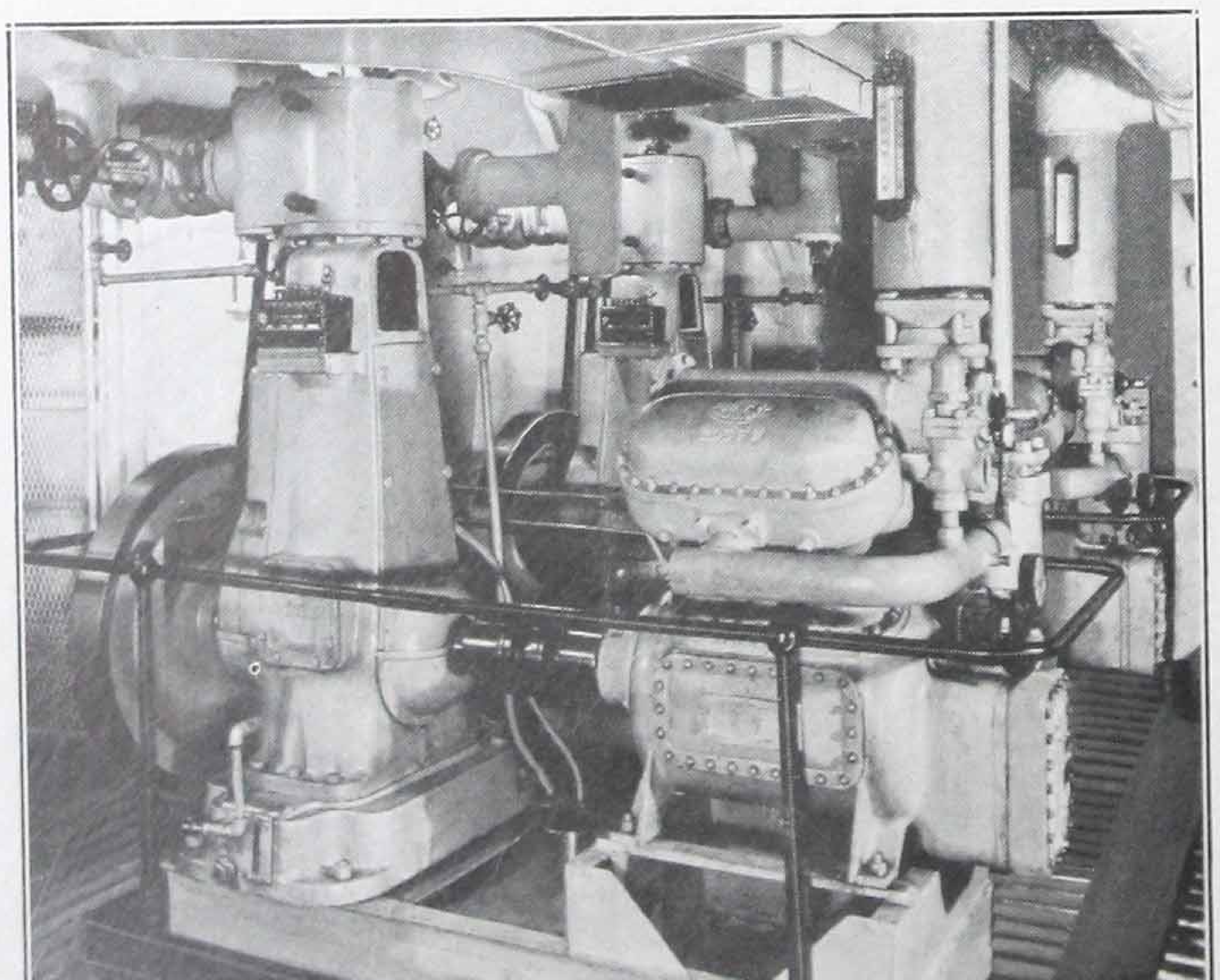


Fig. 52—Two "Eclipse" Compressors, Each with 6 Cylinders, and Driven by a Troy-Engberg Steam Engine. Aboard the Hospital Ship "Wisteria." (U. S. Army Signal Corps Photo)

"Eclipse" Compressors for Freon-12

These machines are the last word in medium-sized equipment using Freon-12. They are ideal for air conditioning work, all kinds of food service, process and research work, marine installations, industrial plants, etc. They are built with 3, 4 or 6 cylinders, all having a bore and stroke of 4¼ by 4¼ inches. They are easily adapted to handling methyl chloride as well as F-12.

Standard operating speeds include 650, 750, and 860 r.p.m. Expressed in round numbers, the capacities are 25 tons refrigeration for the 3-cylinder, 33 tons for the 4-cylinder, and 50 tons for the 6-cylinder machine. Under actual loads the 3-cylinder machine develops from 4 to 34 tons, depending upon its speed, and the temperatures and pressures encountered. V-belt drive, including a grooved flywheel, set of V-belts, and grooved motor pulley, are furnished as standard: any type of drive can be applied.

Capacity controls are fitted to one, two, or more cylinders, when so ordered. The control itself is an automatic device which keeps the suction valve open, thus unloading the cylinder. It is useful both during starting and for regulating ca-

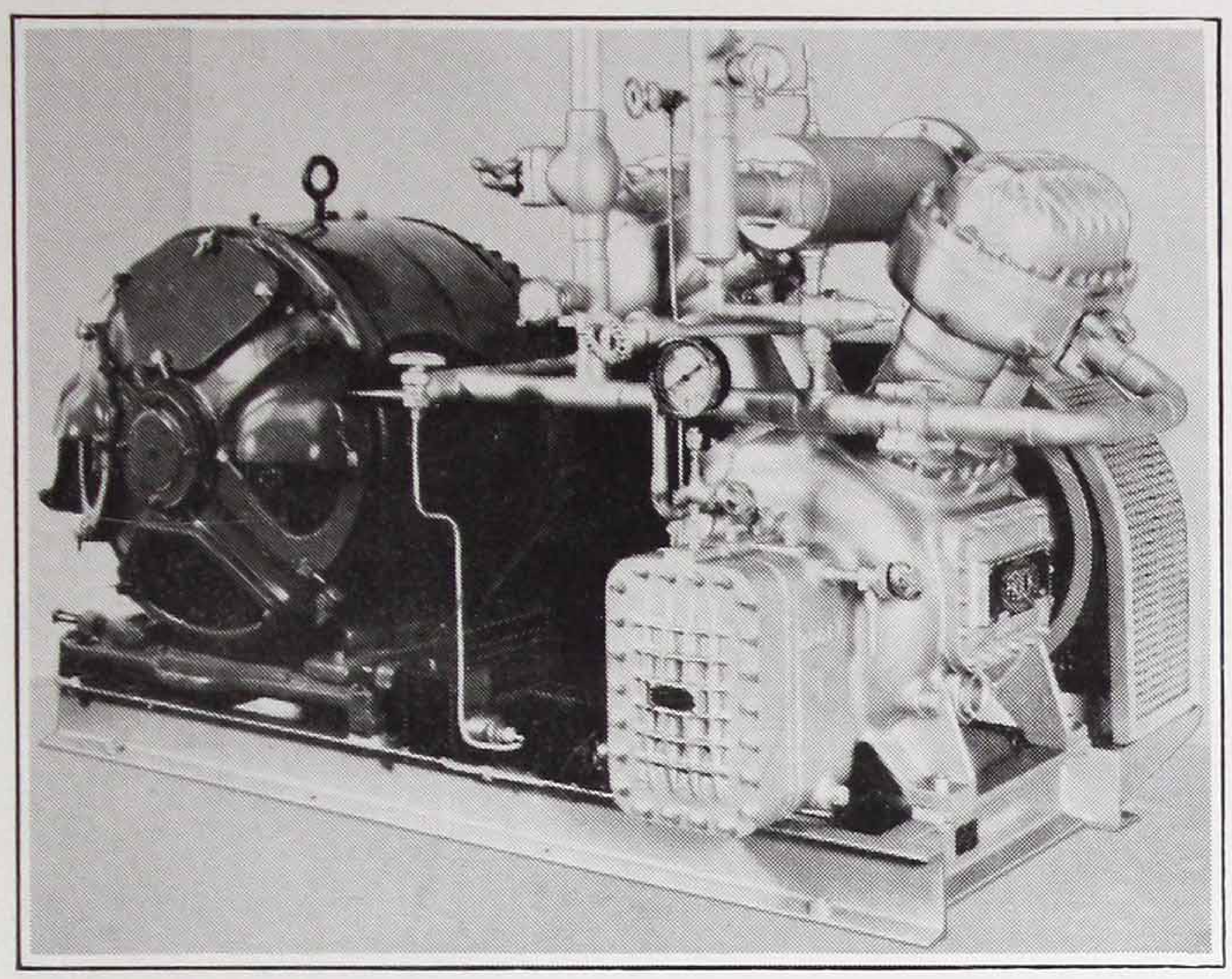


Fig. 54 — Marine-type "Eclipse" Compressor, with Motor Mounted on Same Base. Used on Hundreds of Frick-equipped Ships.

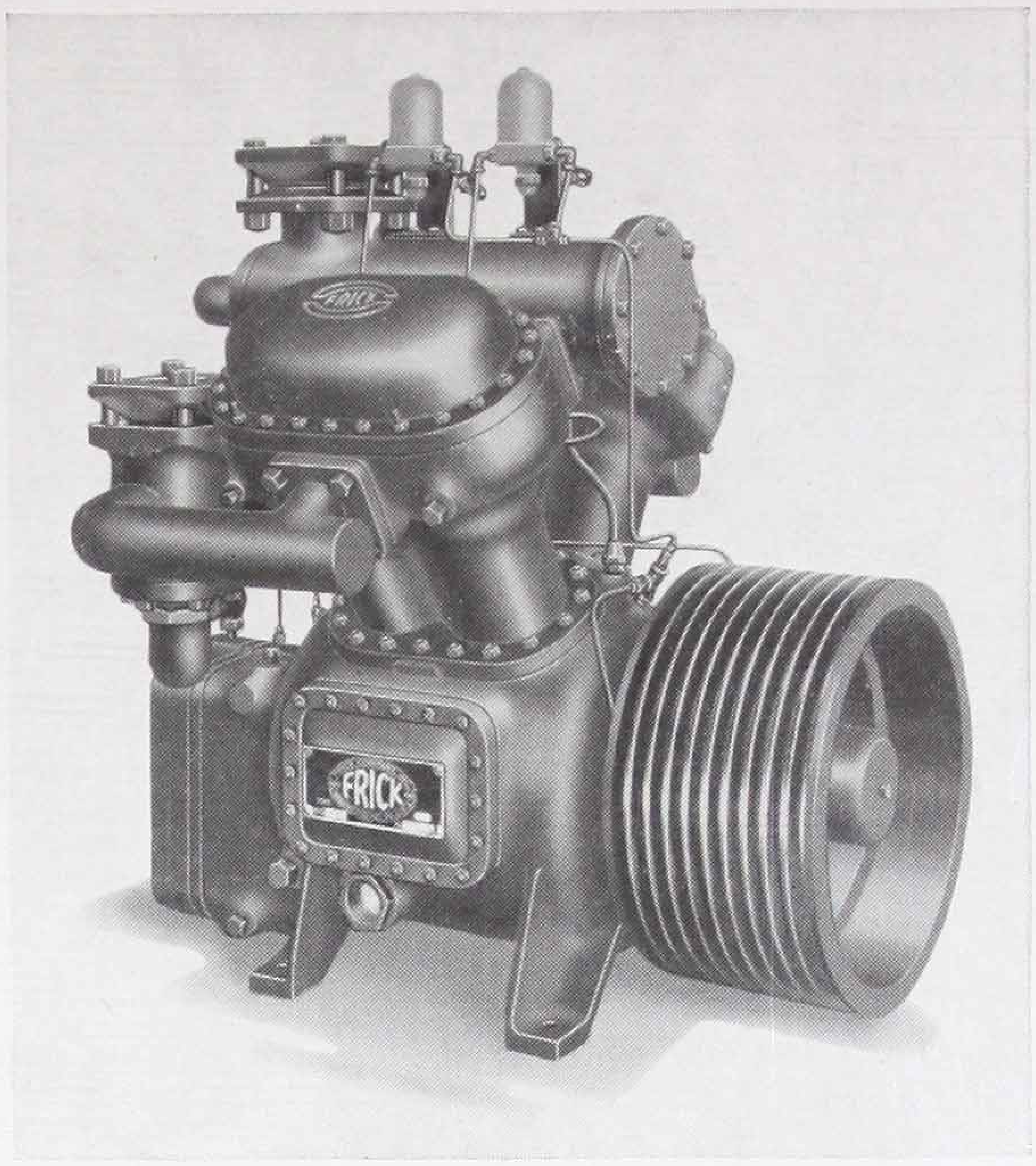


Fig. 55—Four-Cylinder "Eclipse" Compressor, with Unloader Controls Mounted on Top.

pacity. Thermostats and pressurestats, connected to suitable electric valves, cut the cylinders in or out as the load varies.

Force-feed lubrication is used throughout. The oil pump is submerged, and discharges through a very large filter screen. The horsepower required per ton is less with an "Eclipse" machine than in many larger types of other makes. Reasons for this are the excellent lubrication, large bearing surfaces, over-sized gas passages and valve areas, and location of the ring-plate suction and discharge valves in the safety heads, which permit the use of very small clearance. On air conditioning work it is usual to figure one horsepower per ton of refrigeration, when using these machines. They give an exceptionally large capacity in a small space; the six-cylinder machine measures only 39¼″ high by 34″ over the discharge manifolds, by 44½″ long.

While compactly arranged, every part of the machine is readily accessible, and almost all parts can be inspected without disturbing the pipe connections. The Frick patented Flexo-Seal, which requires no adjustment, is used at the shaft. The machine is furnished, as standard, complete with V-belt drive, also with oil pressure gauge, first charge of oil, suction scale trap, suction and discharge service valves, safety relief valve, wrenches and tools, piston ring guide, foundation bolts, and blueprints. Complete details are explained in Bulletin 100.

Fig. 56—Clubs, Taverns, Hotels and Similar Places Find "Eclipse" Machines Fill Their Cooling Needs Completely.

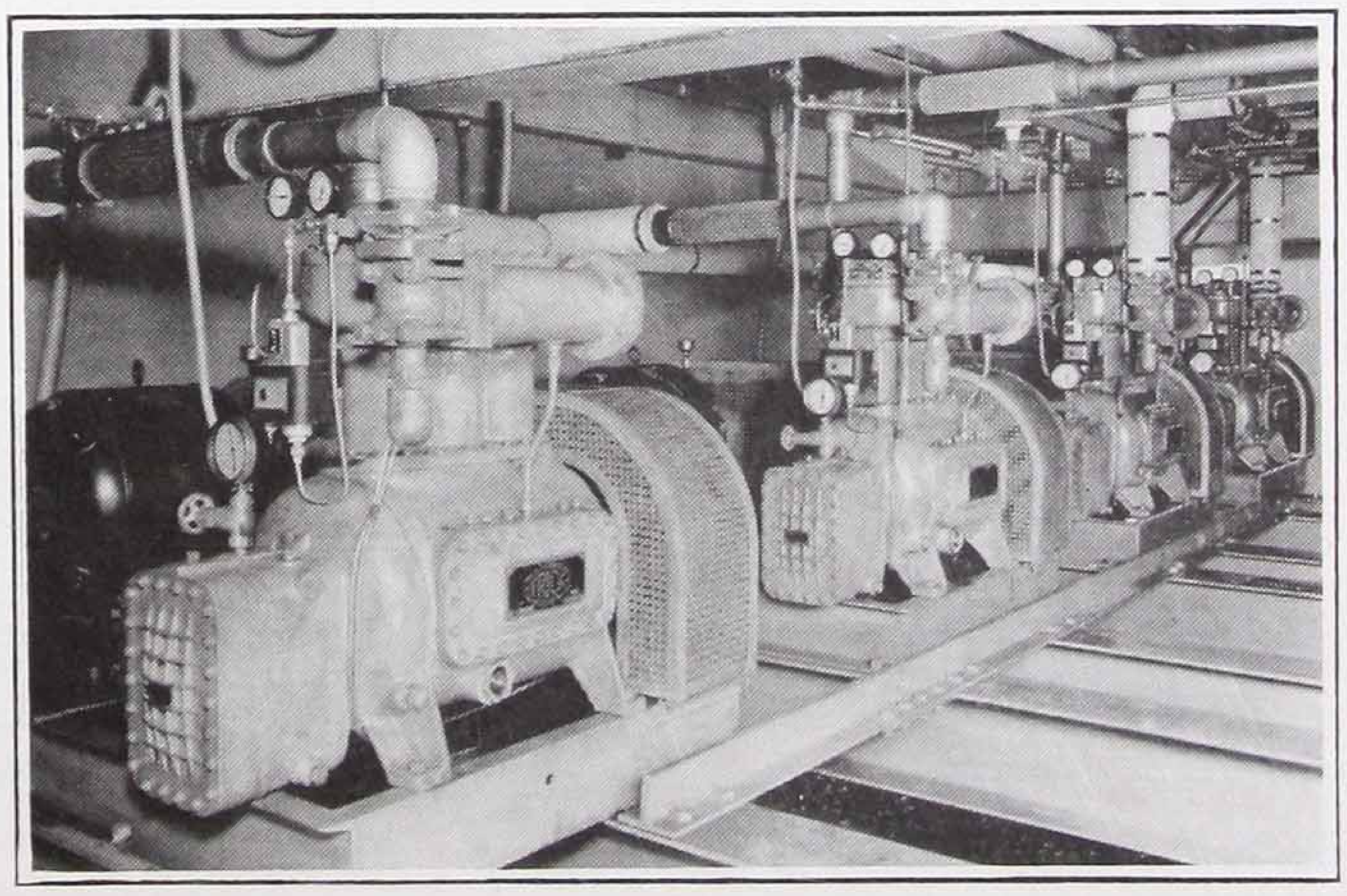


Fig. 57—These 3-cyl. "Eclipse" Machines Air Condition the Rainbow Room at the Ansley Hotel, Atlanta. People in Bedrooms Immediately Below Cannot Hear Them Operate.

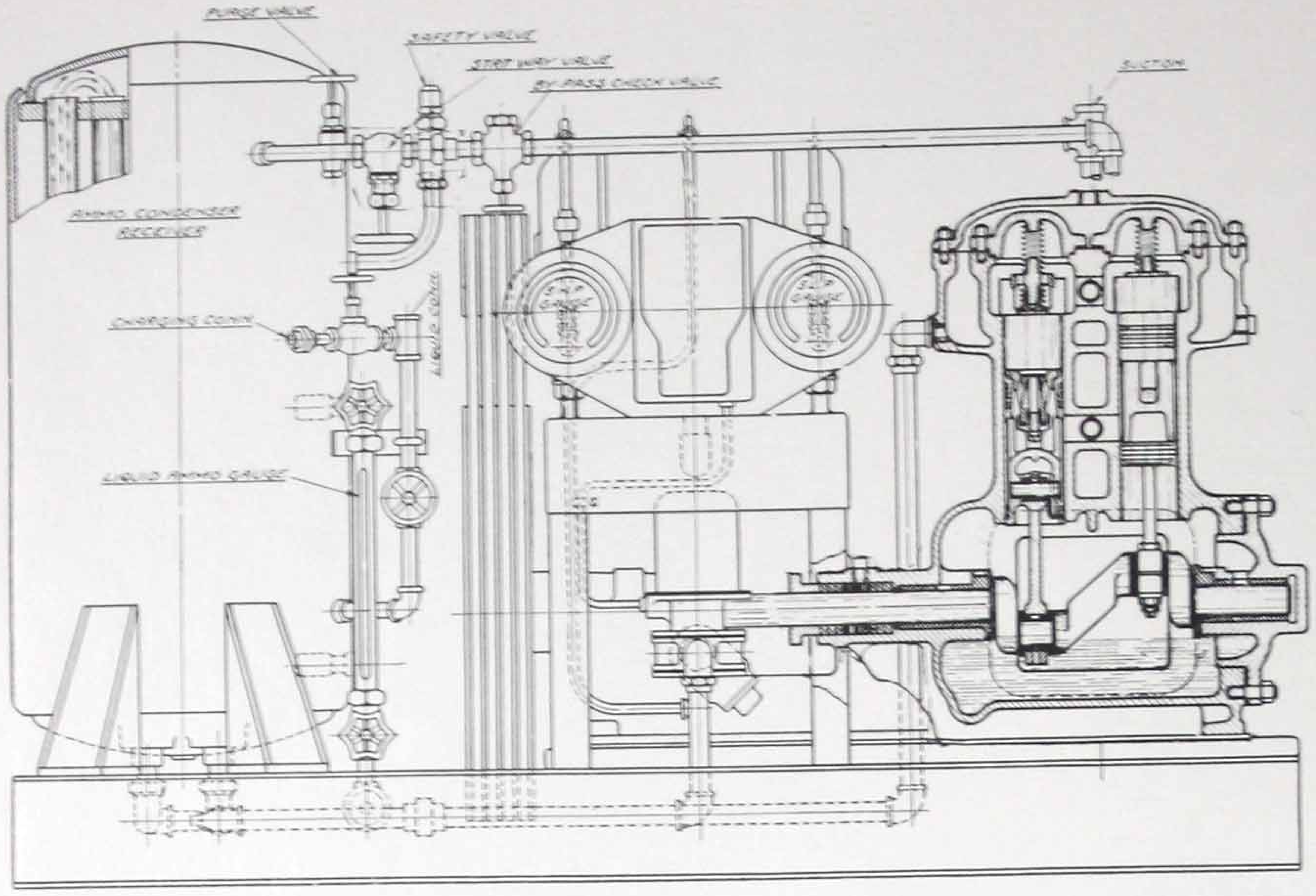
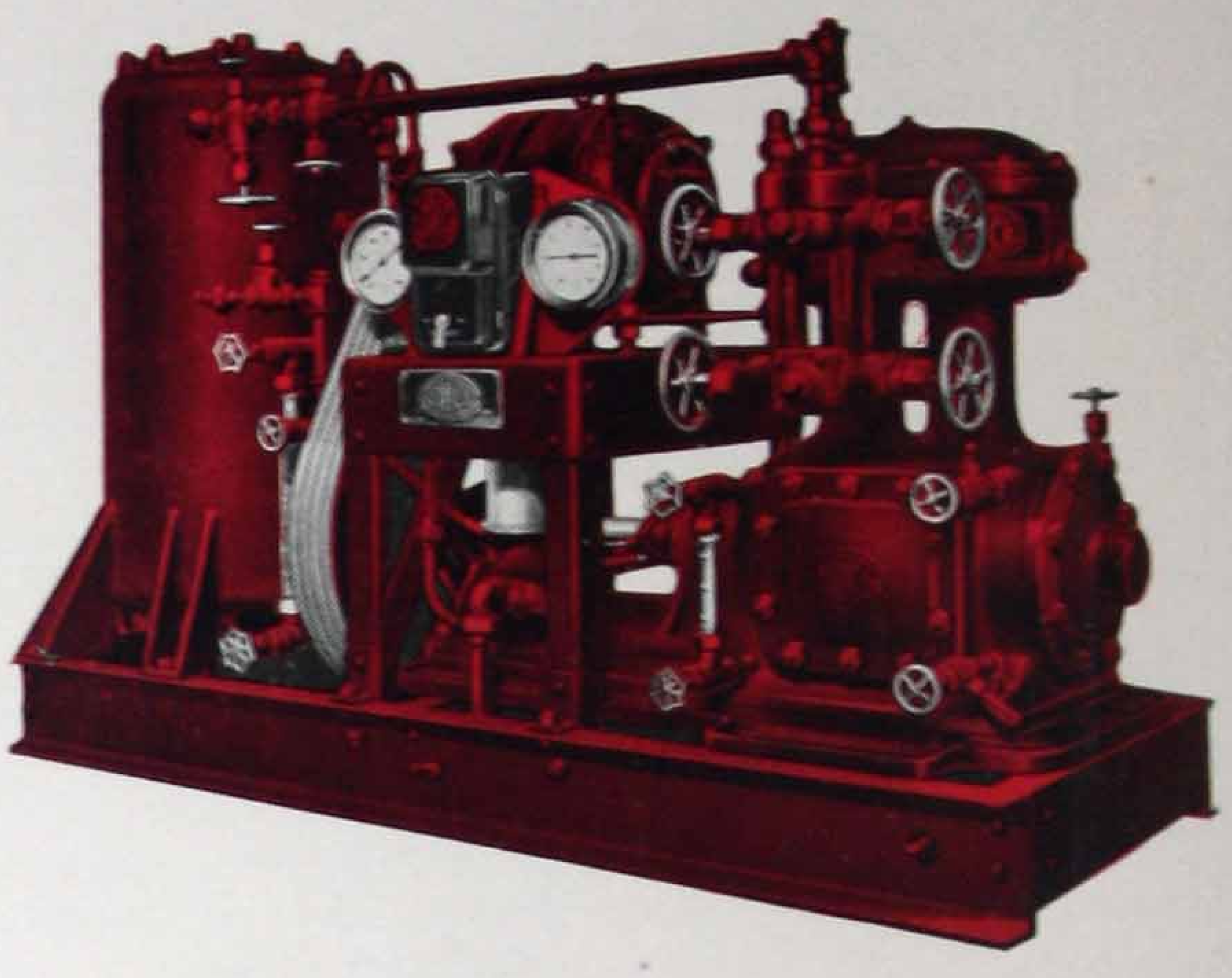


Fig. 58—Section Drawing Through Frick Combined Ammonia Unit of 3″ by 3″ Size. Latest Compressor has 2-Bearing Design and Flexo-Seal.

Fig 60 (Below) — Frick Combined Ammonia Units are both Sturdily Constructed and Pleasing in Appearance.



Combined Ammonia Units

A combined refrigerating unit is one having the working parts, including the compressor, motor drive, condenser-receiver and controls, mounted on the same frame. Being completely assembled and tested before shipmnt, it can be quickly put into operation by running connections to the cooling coils and to the nearest electric, water and drain lines.

The entire unit is compact, will pass through an ordinary door, and requires no special foundations, the steel channels providing a firm base. If no electricity is available, the motor, motor base, starter and V-belts are omitted, and a crowned flywheel is usually supplied, for use with a flat belt.

These units are built in three sizes, each with 2 cylinders: 3″ by 3″, 4″ by 4″, and 5″ by 5″ (bore and stroke). The horsepowers required range from 5 to 20, and the capacities vary from 2½ to 10 tons of refrigeration. The compressors are of the standard Frick enclosed type, as shown on pages 14 to 18.

The combined condenser-receivers are of the shell-and-tube type, made of large OD pipe with steel heads, 1″ thick, welded in place. They are amply large for the service, and perform satisfactorily with limited amounts of cooling water, which is directed through one of the tubes after another by pockets cast in the water heads.

By removing these heads the tubes, being straight, can be readily cleaned. A safety sight gauge shows the quantity of liquid in the receiver.

The units are equipped as standard with automatic motor starter, water regulator, and high-pressure cutout (for stopping in case of water failure). By adding a small thermostat and other control devices to suit conditions, the operation of the system can be made full-automatic. Hand control can be used when desired.

High-pressure relief valves are furnished on the compressor and condenser-receiver; these discharge

Fig. 59—Fishing Vessels carry 1/3 Less Ice and 1/3 More Fish When the Holds are Cooled with Frick Combined Units. Larger Vessels use these Machines for Food Service, Cooling Drinking Water, Making Ice, etc.

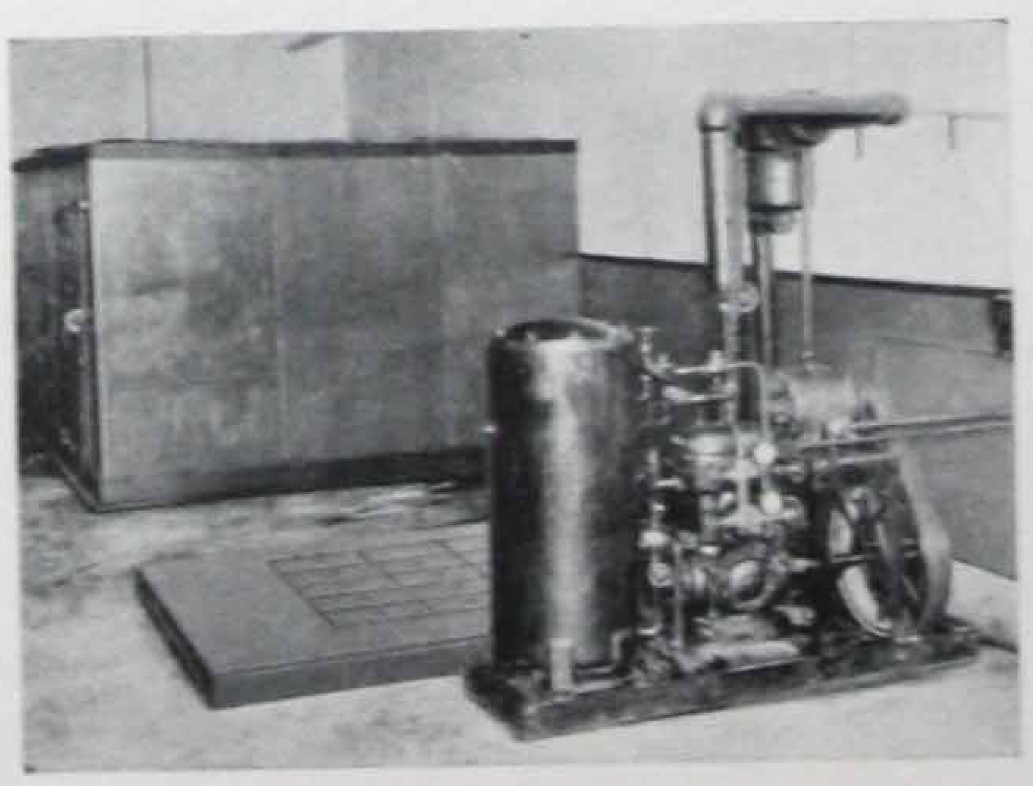


Fig. 61—Milk Store Room and Ice-making Tank Connected to Combined Unit at a Dairy Farm.

Fig. 62—Hospital at Winston-Salem, N. C., Using 5″ by 5″ Unit to Hold 7 Boxes at 38° F and Make 2 Tons of Ice.

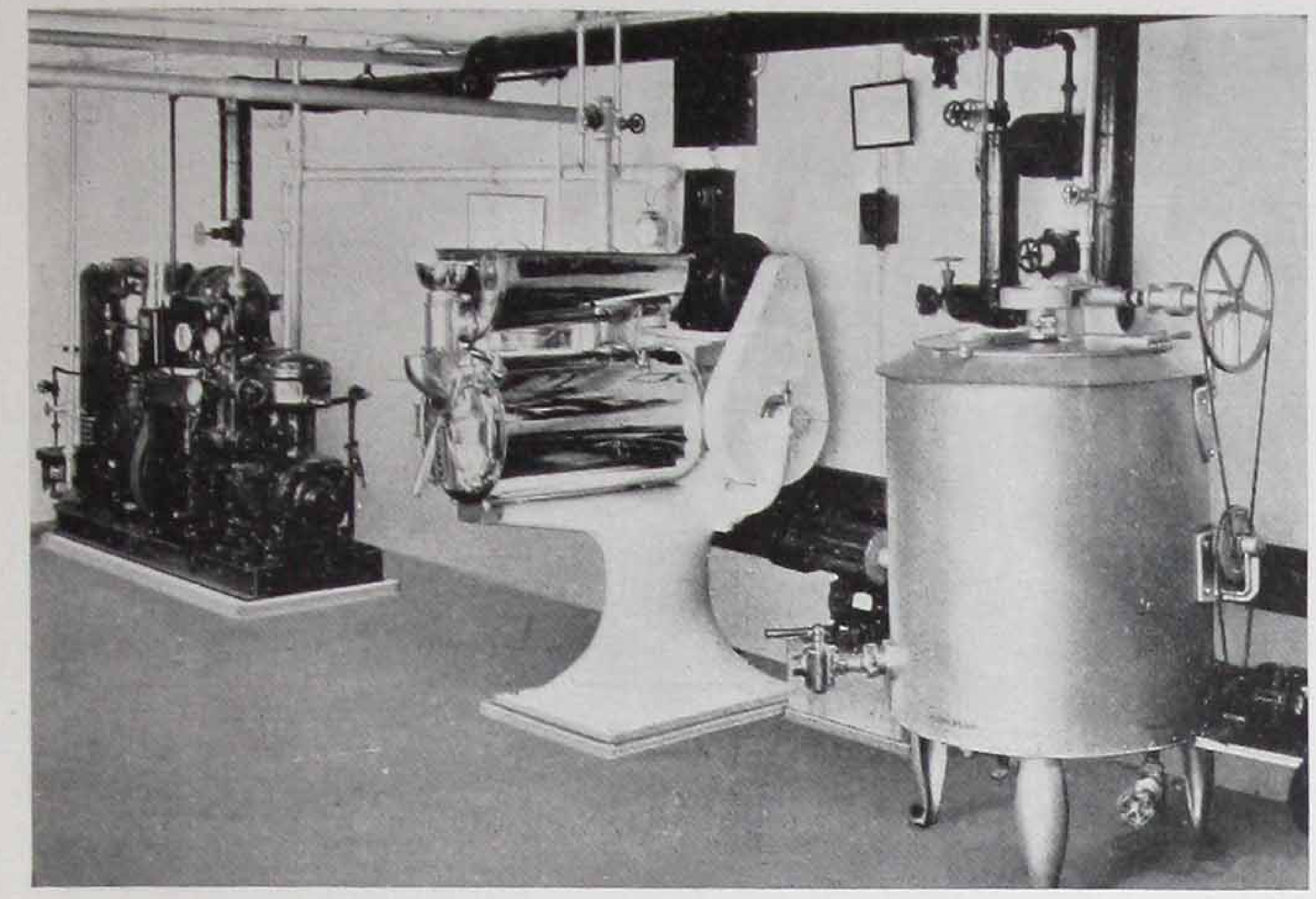


Fig. 63—Frick 4″ by 4″ Unit in the Ice Cream Plant of Adolph Bettells at Bridgeport, Conn., Which Includes a Brine Tank, Hardening Room, and 8-Hole Ice Cream Cabinet

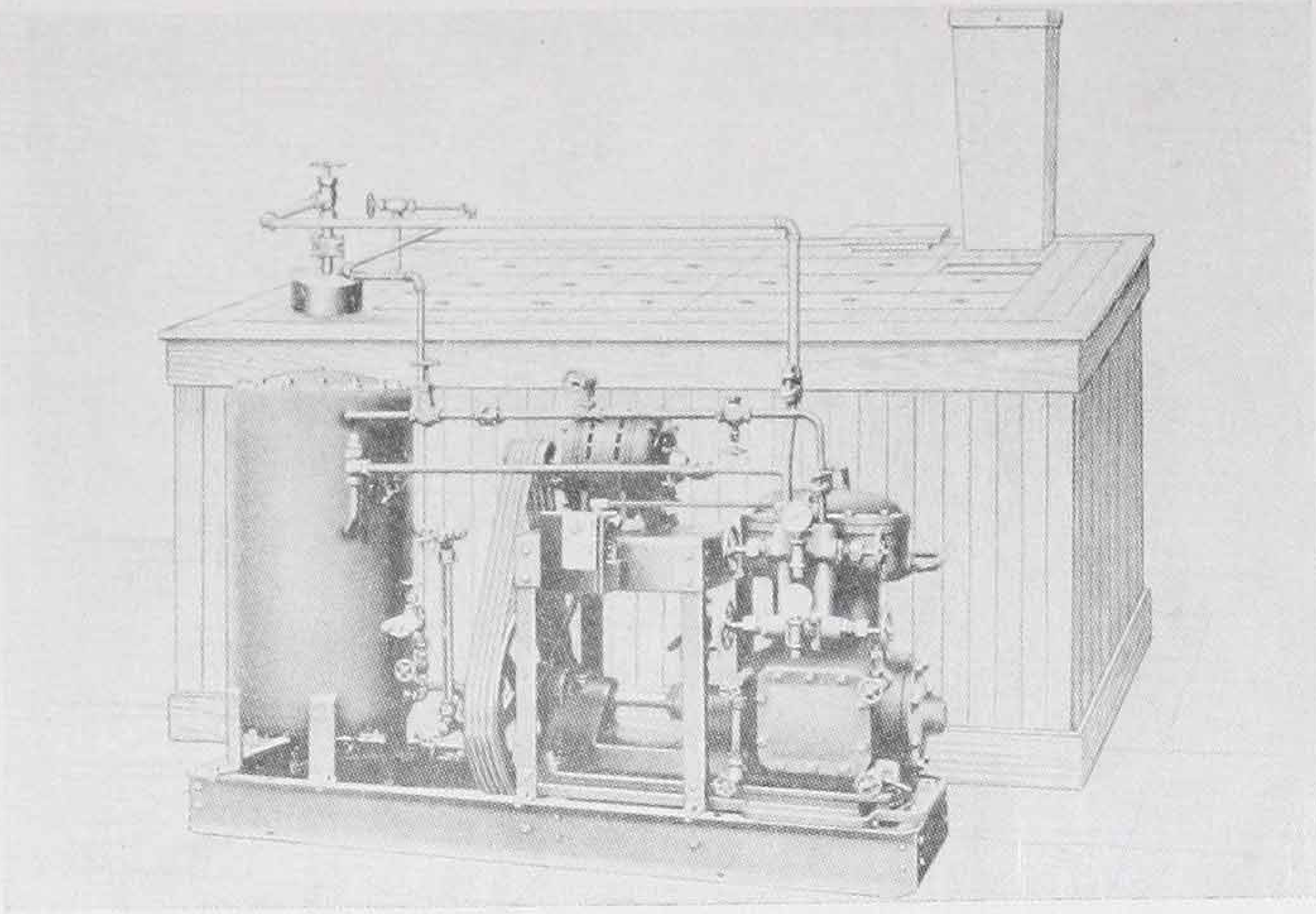


Fig. 65—Two-cylinder 3″ by 3″ Unit Connected to a Frick Ice-making Tank of 2800 Lb. Daily Capacity. Such Freezing Systems are Built in Various Sizes.

into the suction side of the system. Gauge valves have ball checks which close in case the glass is broken. These features, with safety cylinder heads and other details as shown on the following pages, make the units both safe and dependable in operation. Given reasonable care, they will serve effectively for 25 to 40 years. Bulletin 104 describes these units in detail.

In writing for estimates, describe fully the refrigerating work to be done. Send, if possible, a sketch showing dimensions of rooms, kind of insulation, etc. State quantity, temperature, and pressure of cooling water; give details of the power to be used, and whether control is to be automatic.

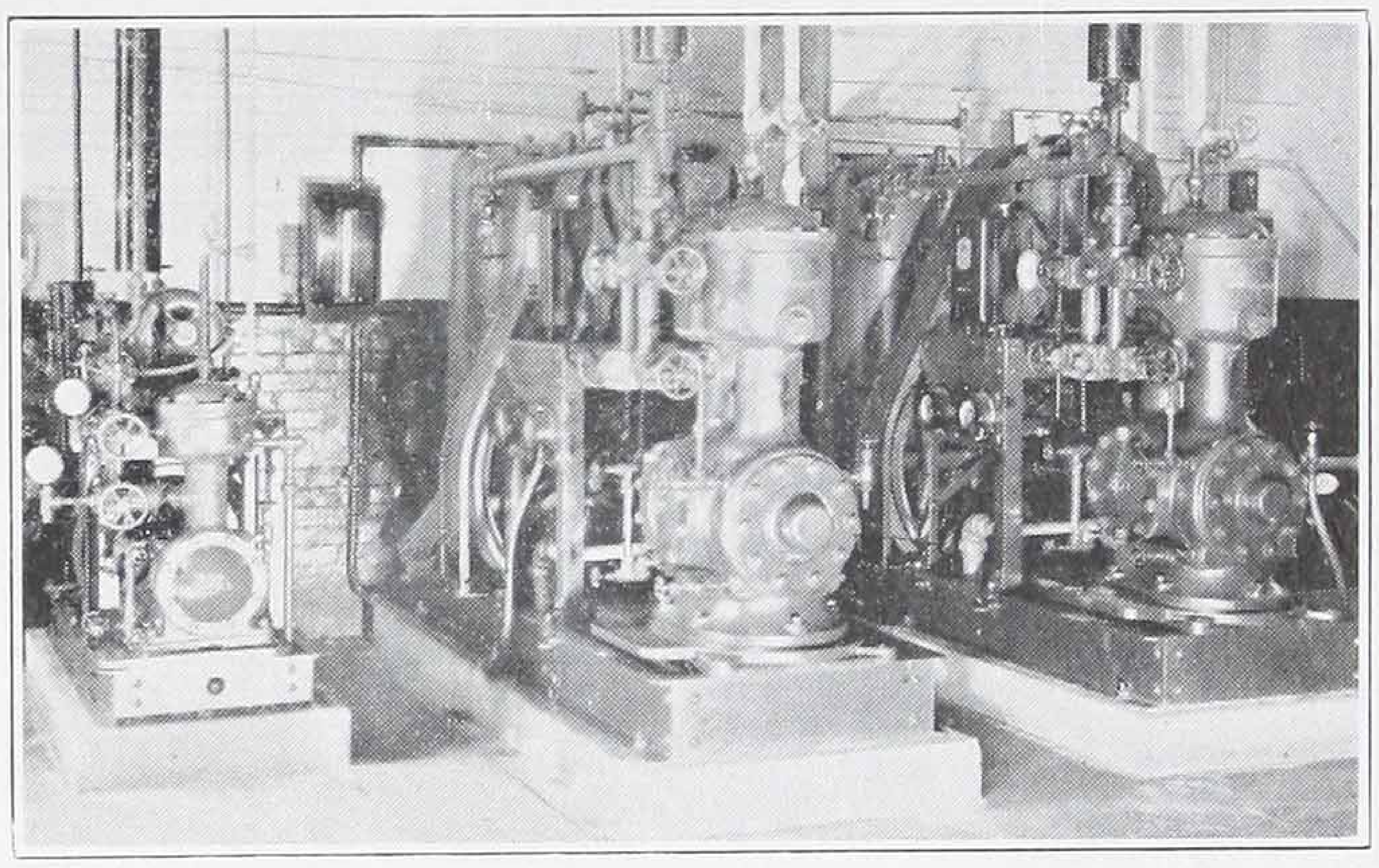


Fig. 65½—3″ by 3″ and 5″ by 5″ Units which Freeze Foods, Make Ice, and Cool Six Storage Rooms at the Richmond, Ind., State Hospital.

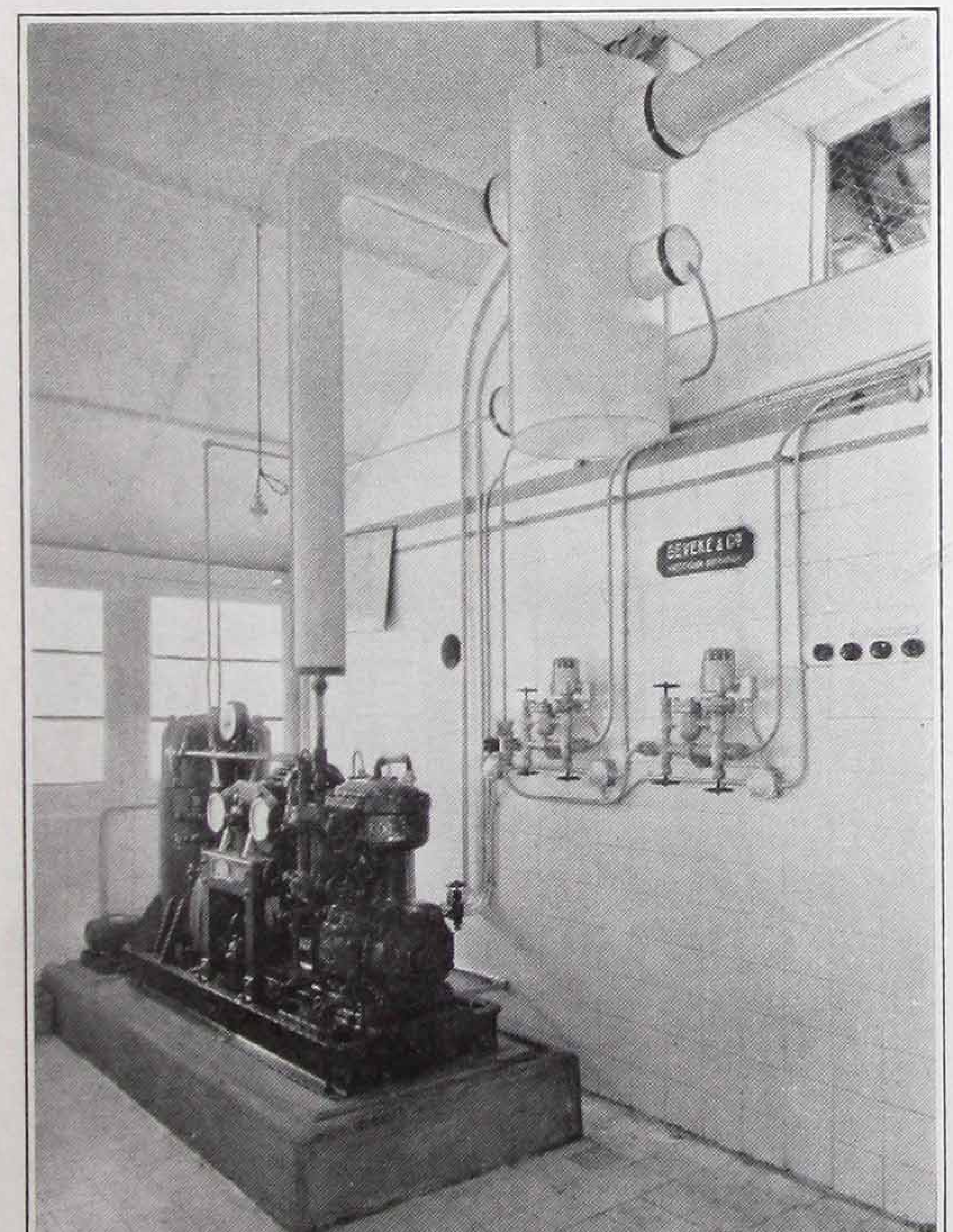


Fig. 64 — 3″ by 3″ Combined Ammonia Unit Installed in a Market at Bandoeng,, Dutch East Indies.

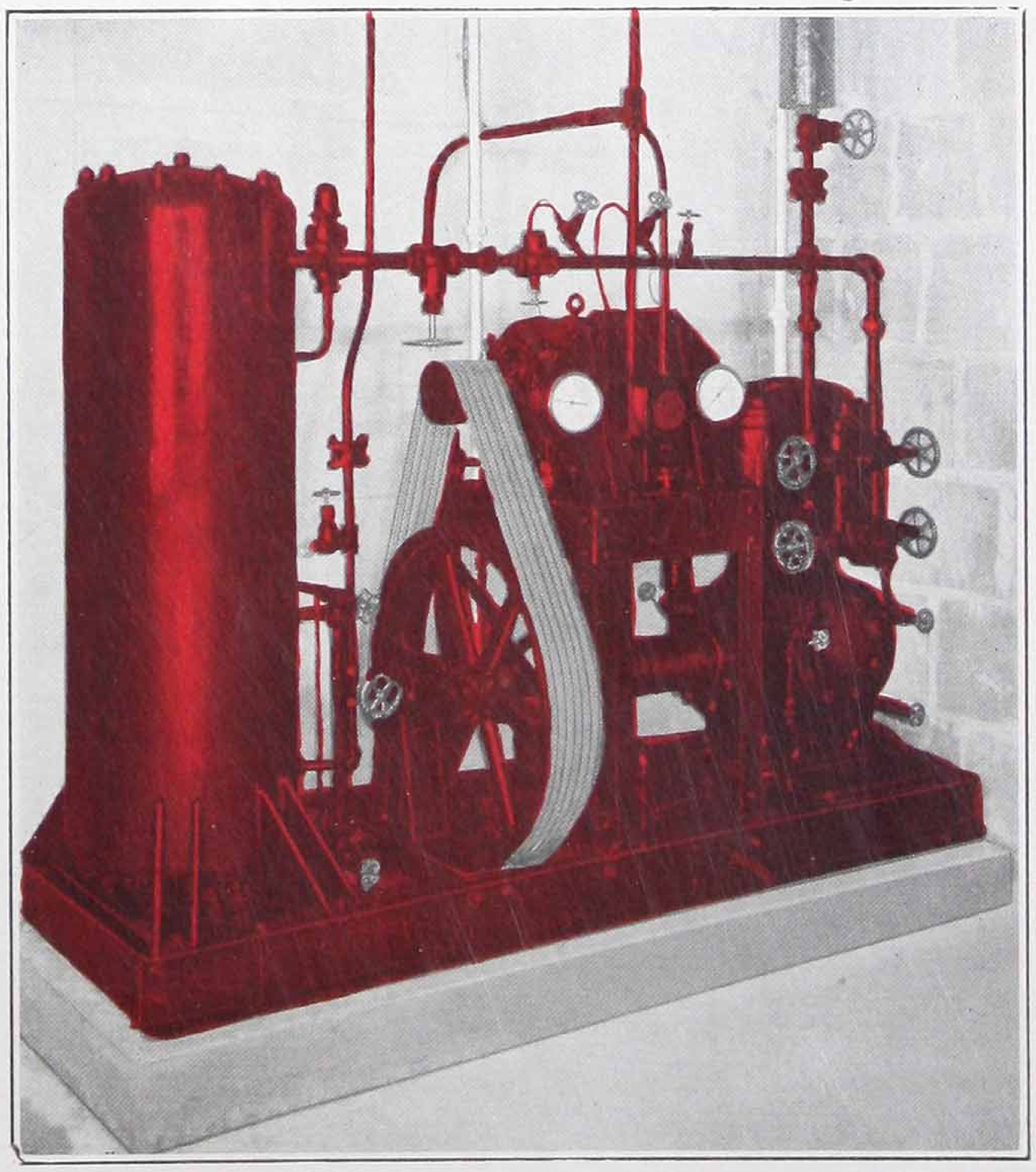


Fig. 66—One of Twenty Frick Ammonia Units in Operation at the Great Niagara Frontier Food Terminal, Buffalo, N. Y. 5″ by 5″ Size is Here Shown.

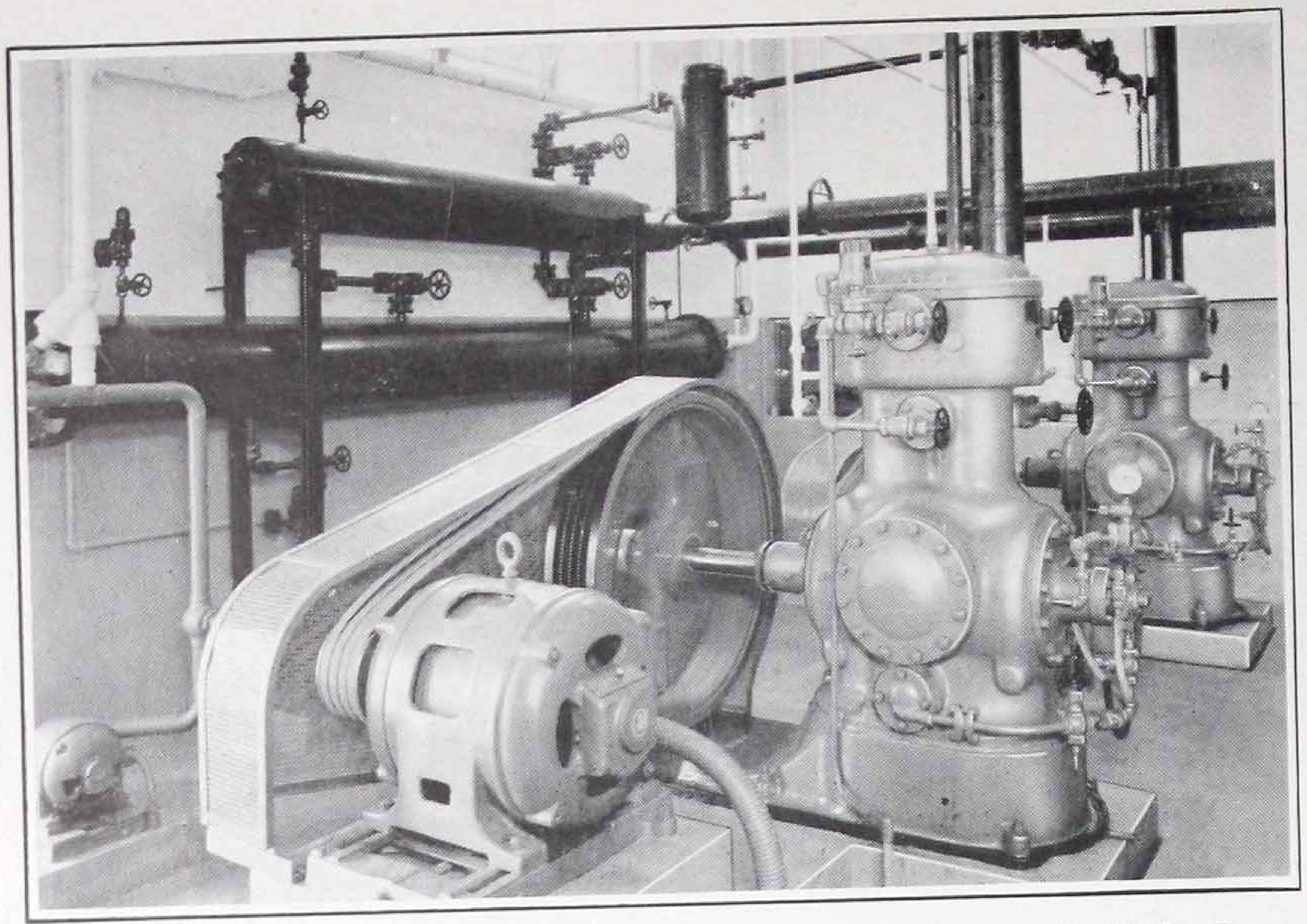


Fig. 67—These 7″ by 7″ Compressors, Equipped with Automatic Unloaders, Cool 13 Rooms and Make Ice at the Naval Air Station, Jacksonville, Fla.

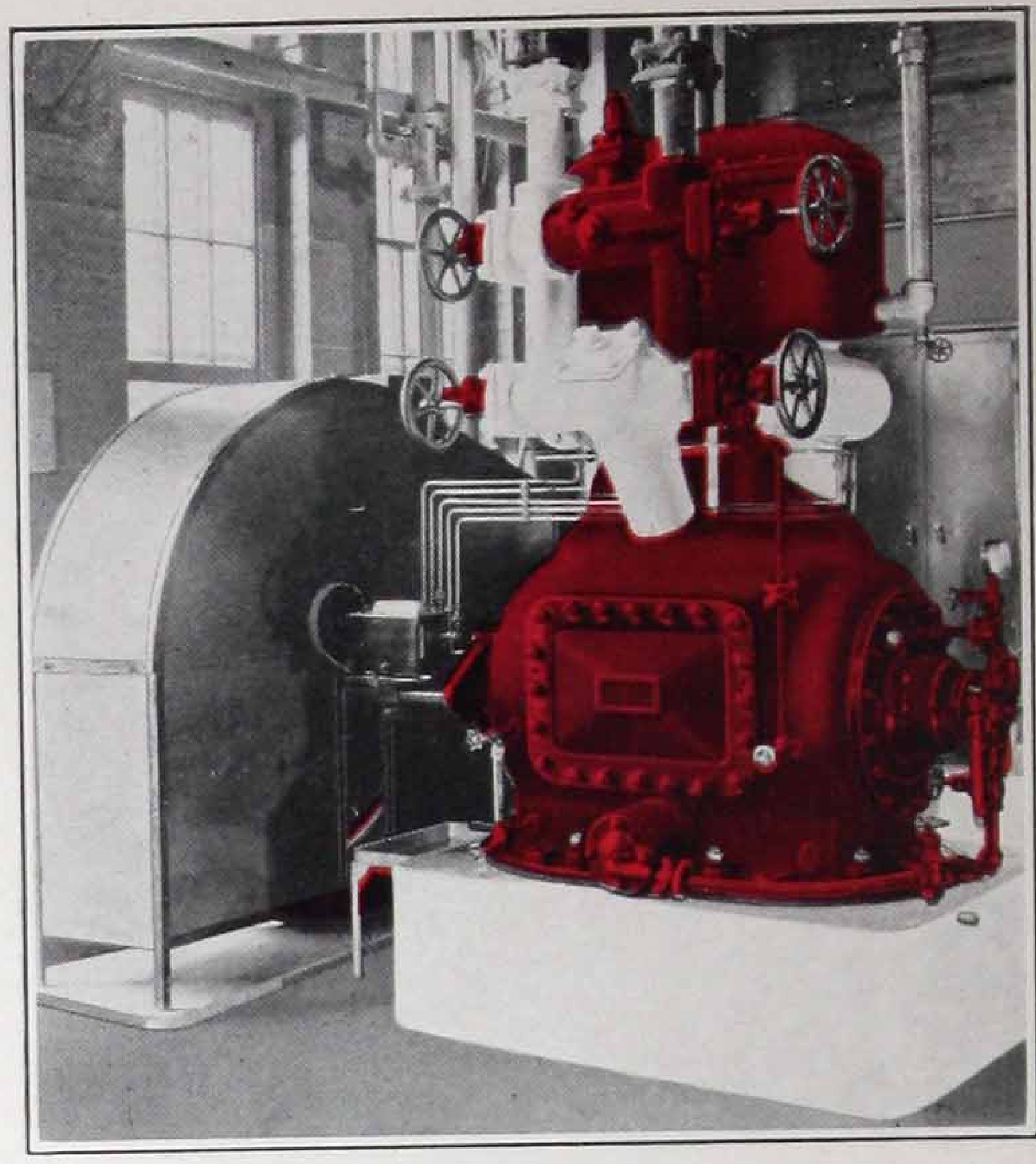


Fig. 69—One of Two Large Frick Machines at the Schreiber Brewery, Buffalo, N. Y. Guard Covers V-belt Drive to Motor. Note 5-Point Lubricator to Cylinders.

Enclosed Ammonia Compressors

These machines have two vertical single-acting cylinders, affording balanaced operation and one-way gas travel. The suction gas enters the cylinders through valves in the top of the pistons, and after being compressed is discharged through plate-type valves in the cylinder heads. Thus the uniflow principle is maintained, with resultant high efficiency of compression, especially since the pistons approach the heads so closely that the clearance is almost nothing.

The enclosed design adapts itself to automatic lubrication and higher operating speeds, and makes the machines most completely dirt-proof and fool-proof. The compressors operate equally well when driven in either direction, and the bypass manifolds can be mounted on either side. They handle ammonia effectively whether wet, saturated ("dry"), or superheated; are suitable for manual or automatic control; can use any kind of drive—whether flat or V-belts, direct-connected synchronous motors, steam or oil engine, water wheel, silent chains, ropes, etc.

On pages 16 and 17 are shown the superior features of construction which make these machines the standard of dependability. Parts subject to wear can be readily renewed, and are all made interchangeable. Cylinder walls are of ample thickness to permit reboring if desired.

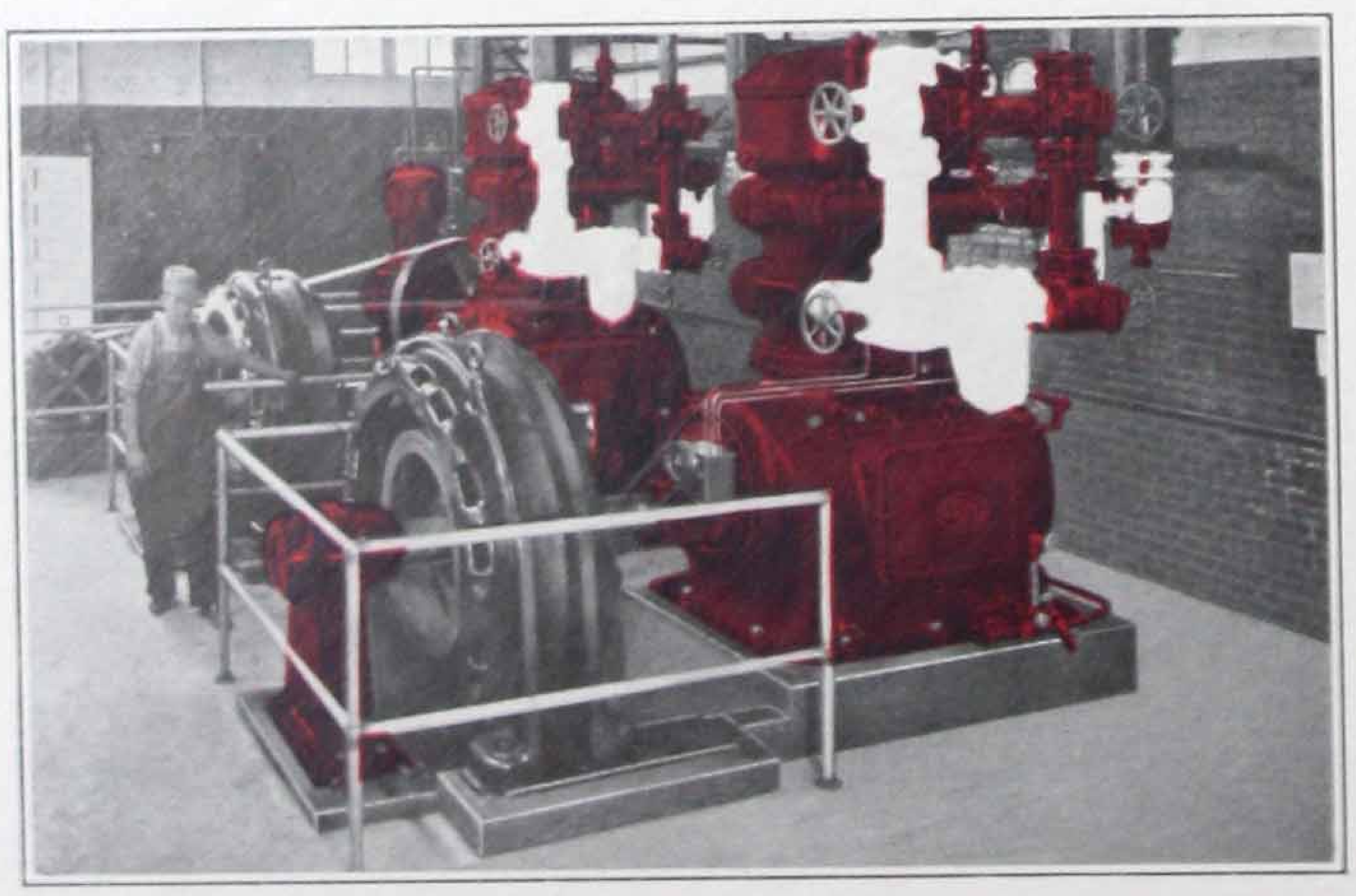


Fig. 68—Dual-Pressure Machines at the Knoxville, Tenn., Plant of the Atlantic Ice Co. Note Double Suction Connections.

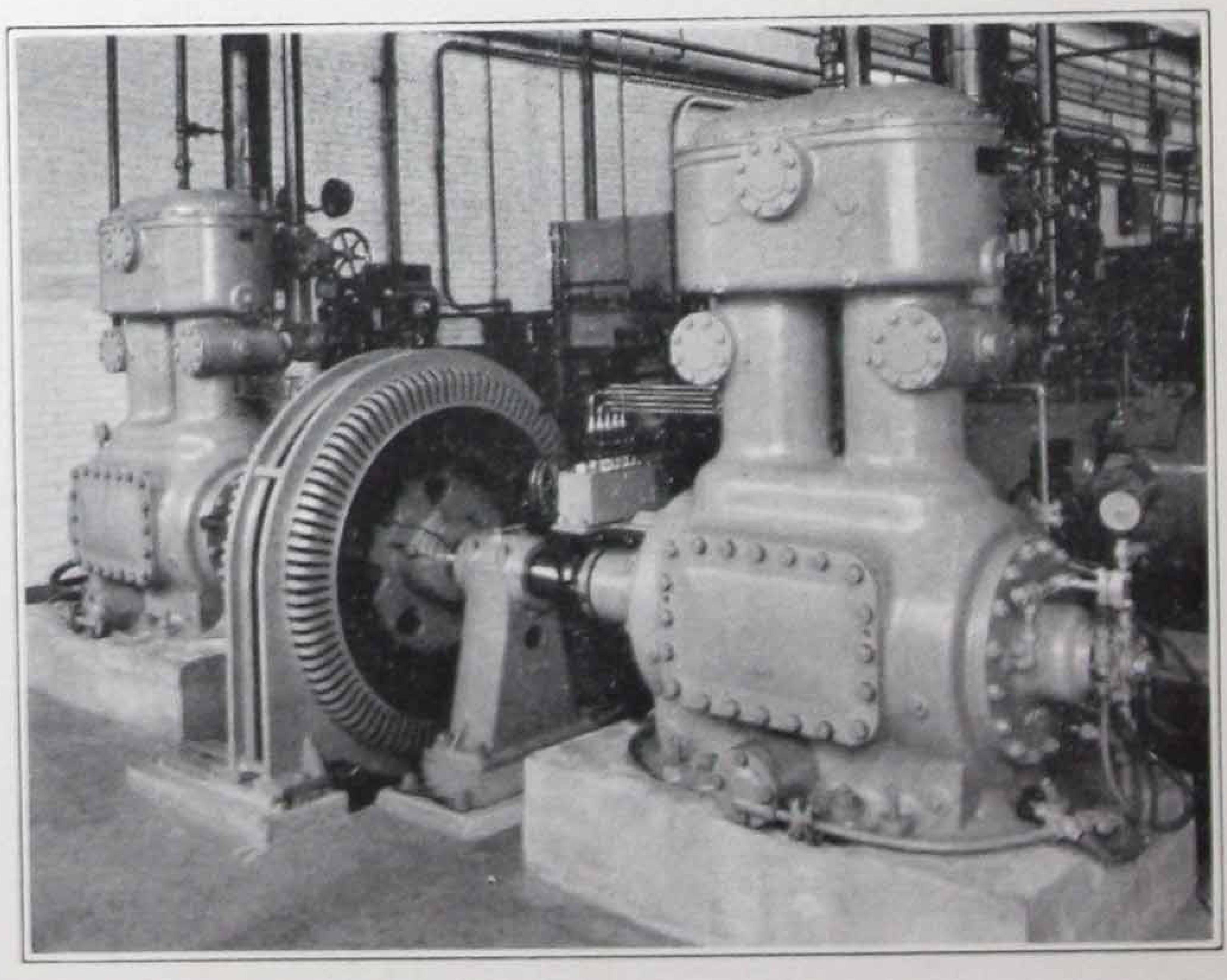


Fig. 70—Pair of 10″ by 10″ Compressors Duplex-Coupled to One Synchronous Motor: Americana Enka Corp.'s Rayon Plant in N. Carolina.

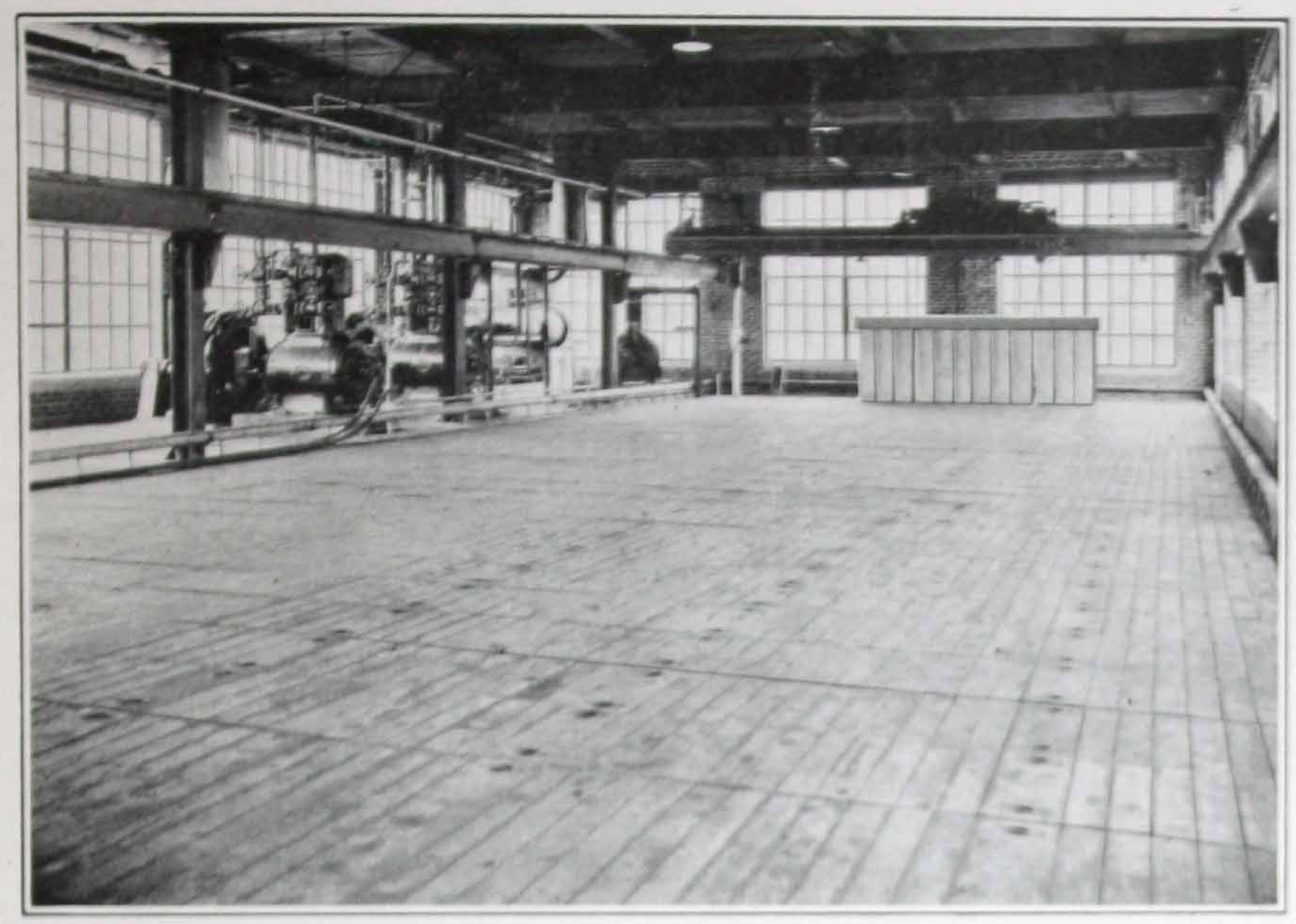


Fig. 71—Two Enclosed Compressors Making 60 Tons of Ice Daily in a Group Lift Plant at Providence, R. I.

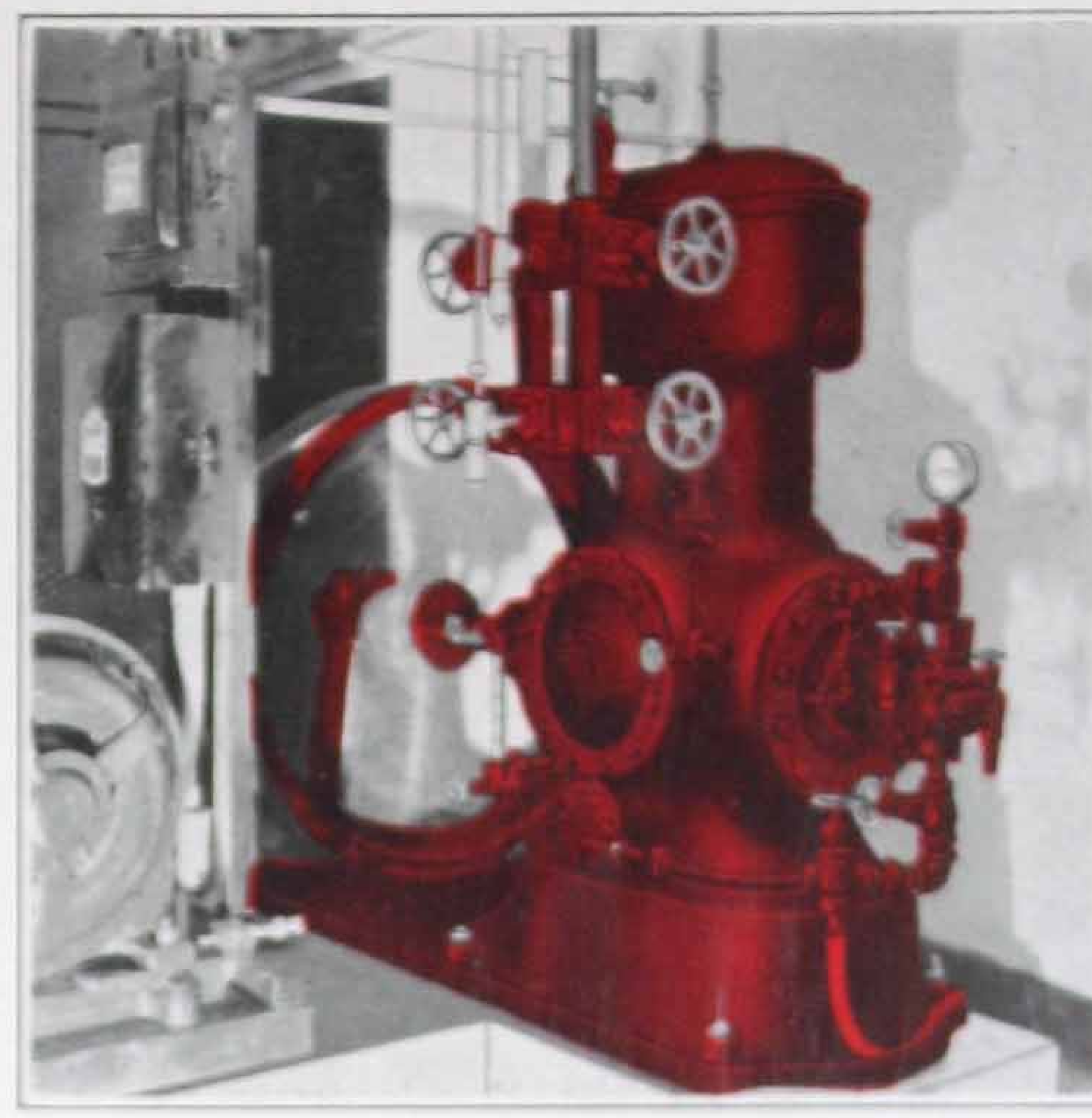


Fig. 72—Schrafft's Restaurant at Newark, N. J., Uses This and Two Other Frick Compressors for Air Conditioning and Food Service. This Famous Chain has Over 145 Frick Machines.

Frick enclosed compressors are built in 10 sizes, with cylinders having the bore equal to the stroke: 3″ by 3″, 4″ by 4″, 5″ by 5″, 6″ by 6″, 7″ by 7″, 8″ by 8″, 9″ by 9″, 10″ by 10″, 11″ by 10″, and 12″ by 12″. (See still larger machines on page 21.) Machines of 7″ by 7″ size and smaller have a base plate supporting the column and outboard bearing, as illustrated. The larger machines have multiple valves, split bearings, separate suction ports to each cylinder (on 10″ by 12″ sizes) and other features required for greater capacities and heavier service.

The 3″ and 4″ machines have splash lubrication, in addition to pumps at the bottom of the connecting rods, to supply oil to the piston pins. All larger sizes have force-feed oiling systems, as shown on the section diagram. Machines in sizes from 8″ to 12″ have mechanical sight-feed lubricators to furnish oil under pressure, a drop at time, to the suction inlet and cylinder walls.

Frick Flexo-Seals (see page 20) are standard for 3″, 4″ and 5″ compressors, and are optional equipment, at additional cost on others, which normally have soft packing at the stuffing-boxes.

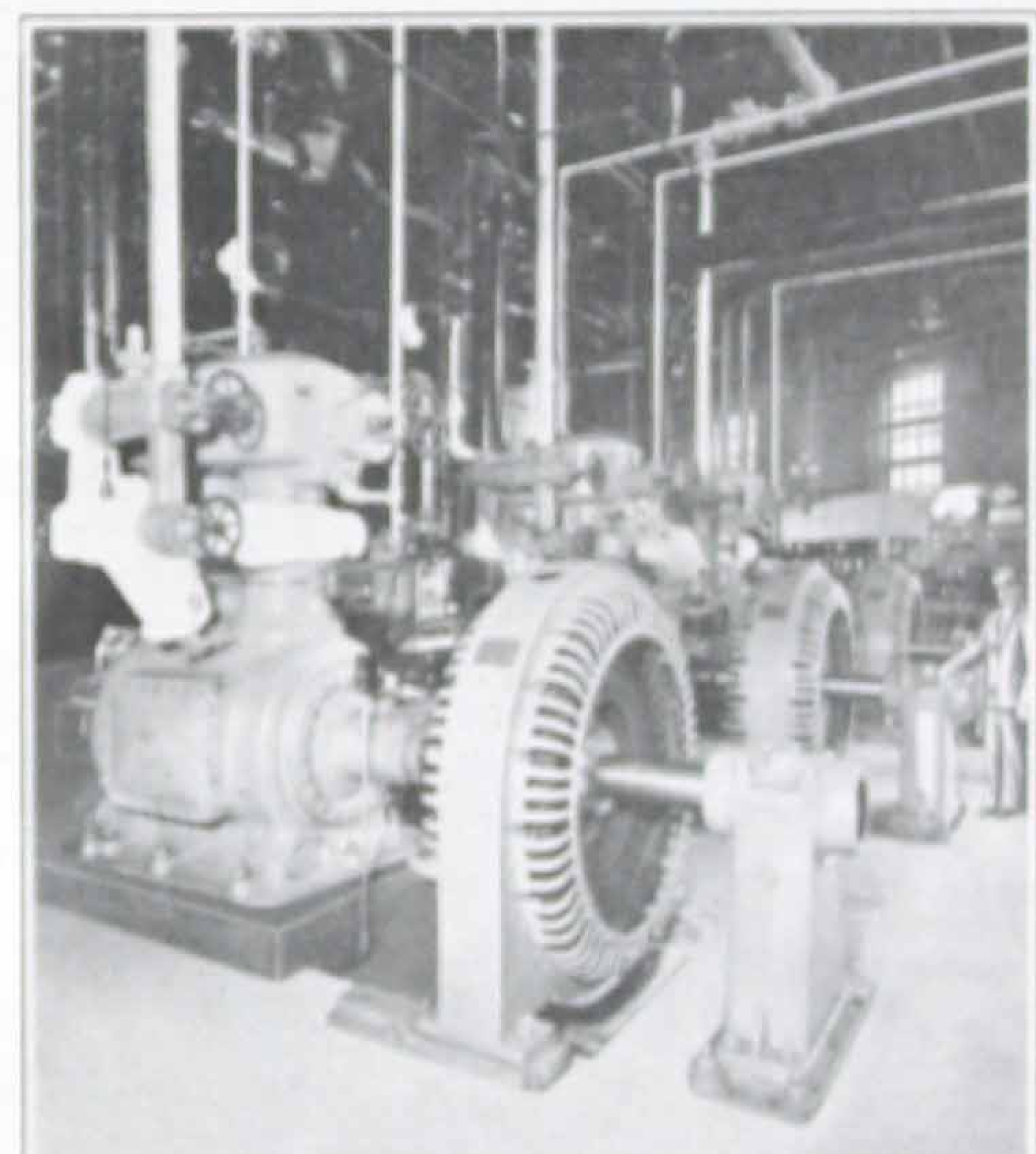


Fig. 73—Noel and Co., at Nashville, Tenn., Save $20,000 Yearly on Power with a Frick Ammonia Booster System and the Enclosed Machines Illustrated.

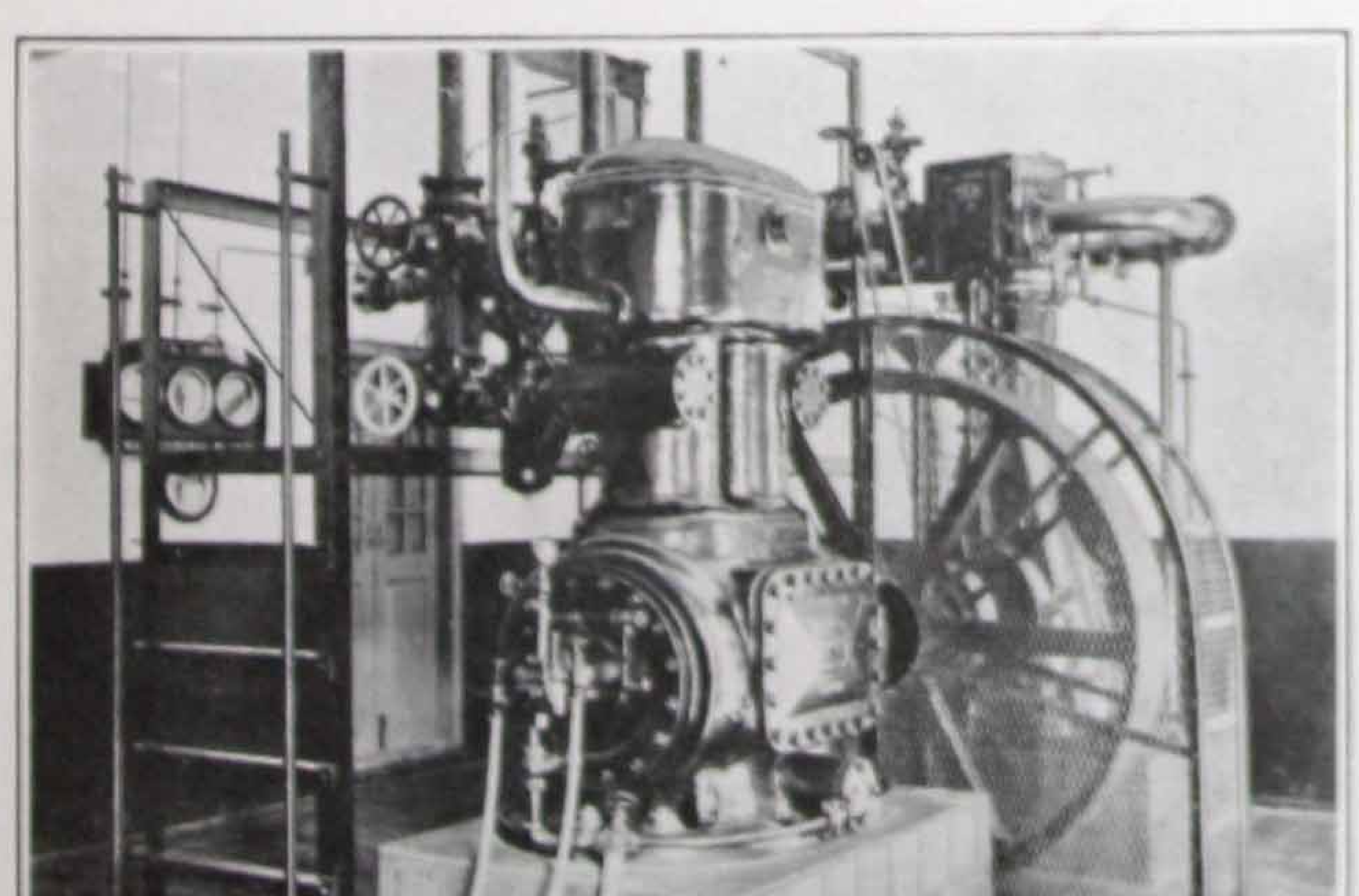


Fig. 71½—10″ by 10″ Machine Driven by Vertical Troy Steam Engine; Mandalay Ice Co., Burma.

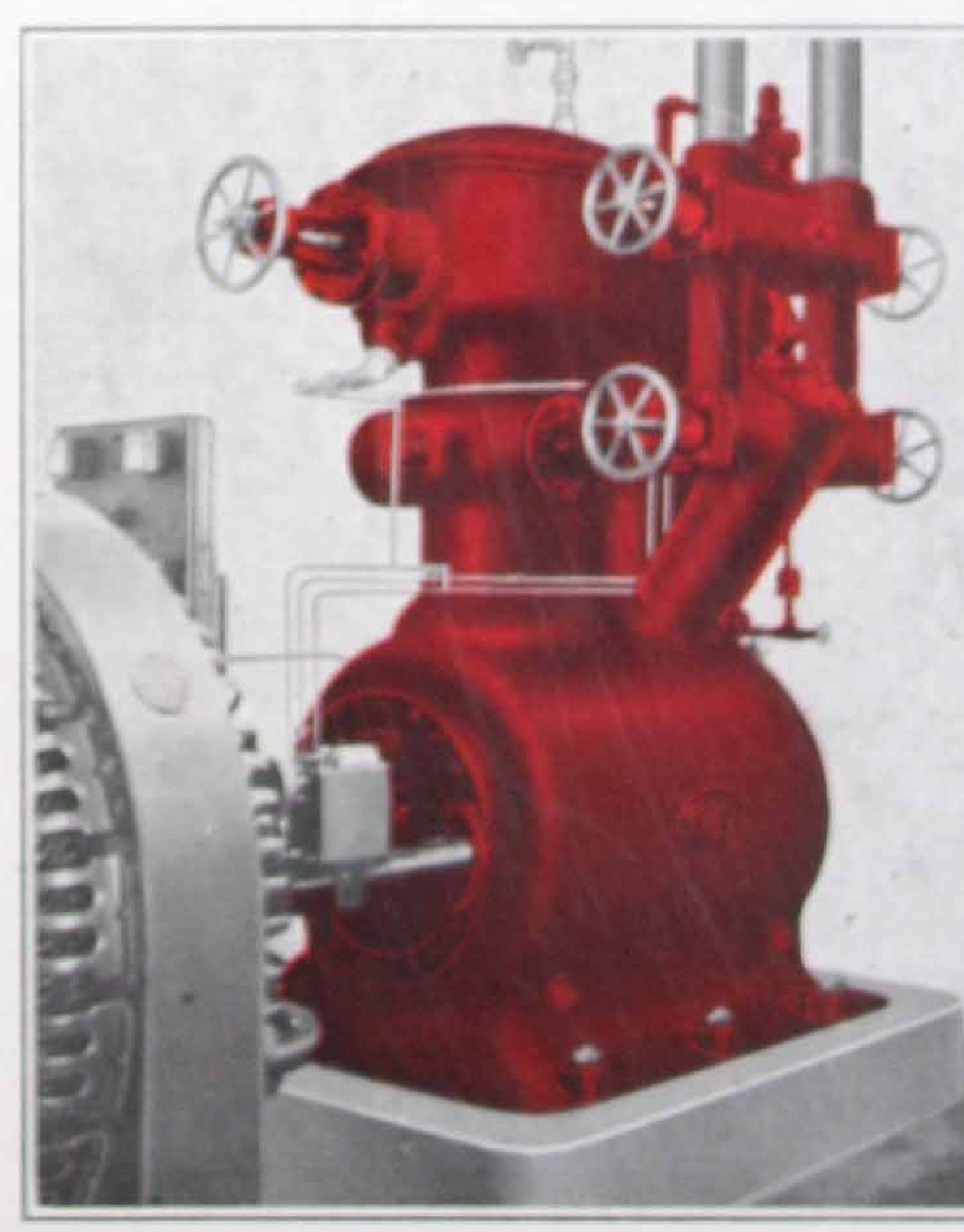
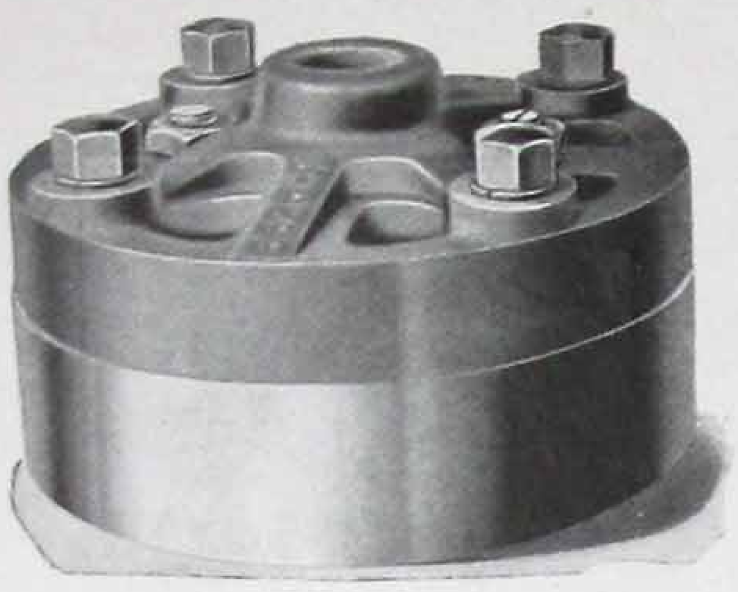
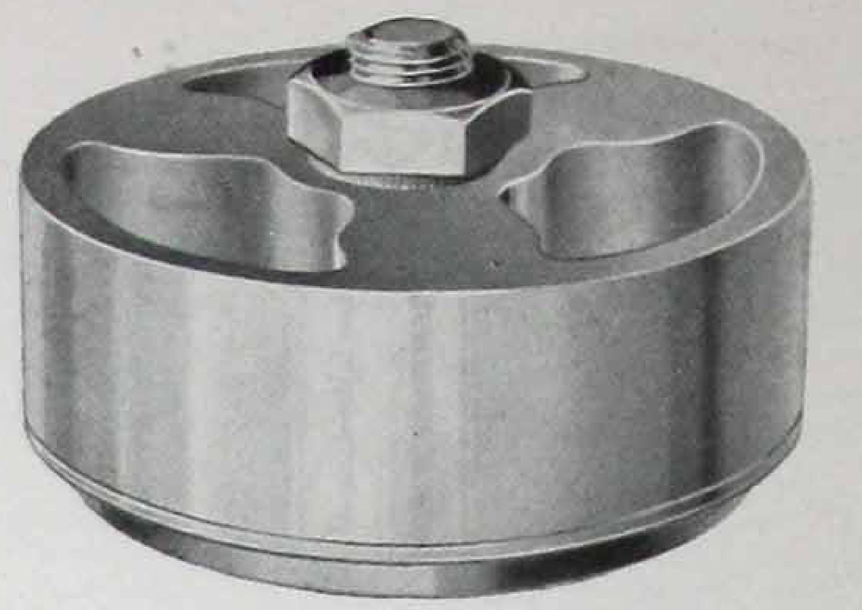


Fig. 74—12 by 12 Machine with Capacity Control —One of Six Frick Compressors at the Great Chestnut Farms Dairy, Washington, D. C.



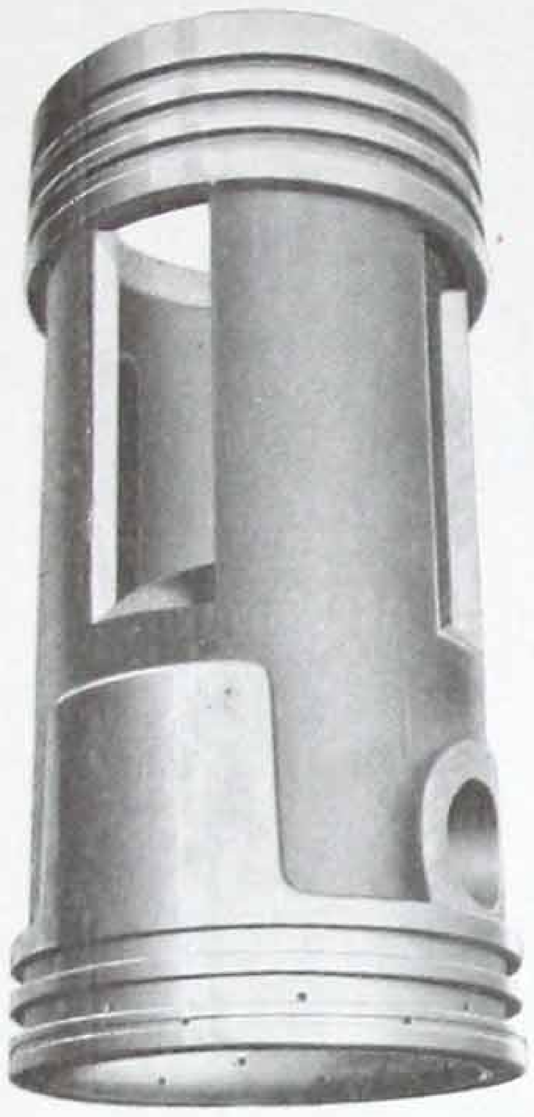
A—Safety cylinder heads, held down by heavy springs instead of bolts, lift in case slugs of liquid ammonia enter: wasteful clearance space is thus safely eliminated.



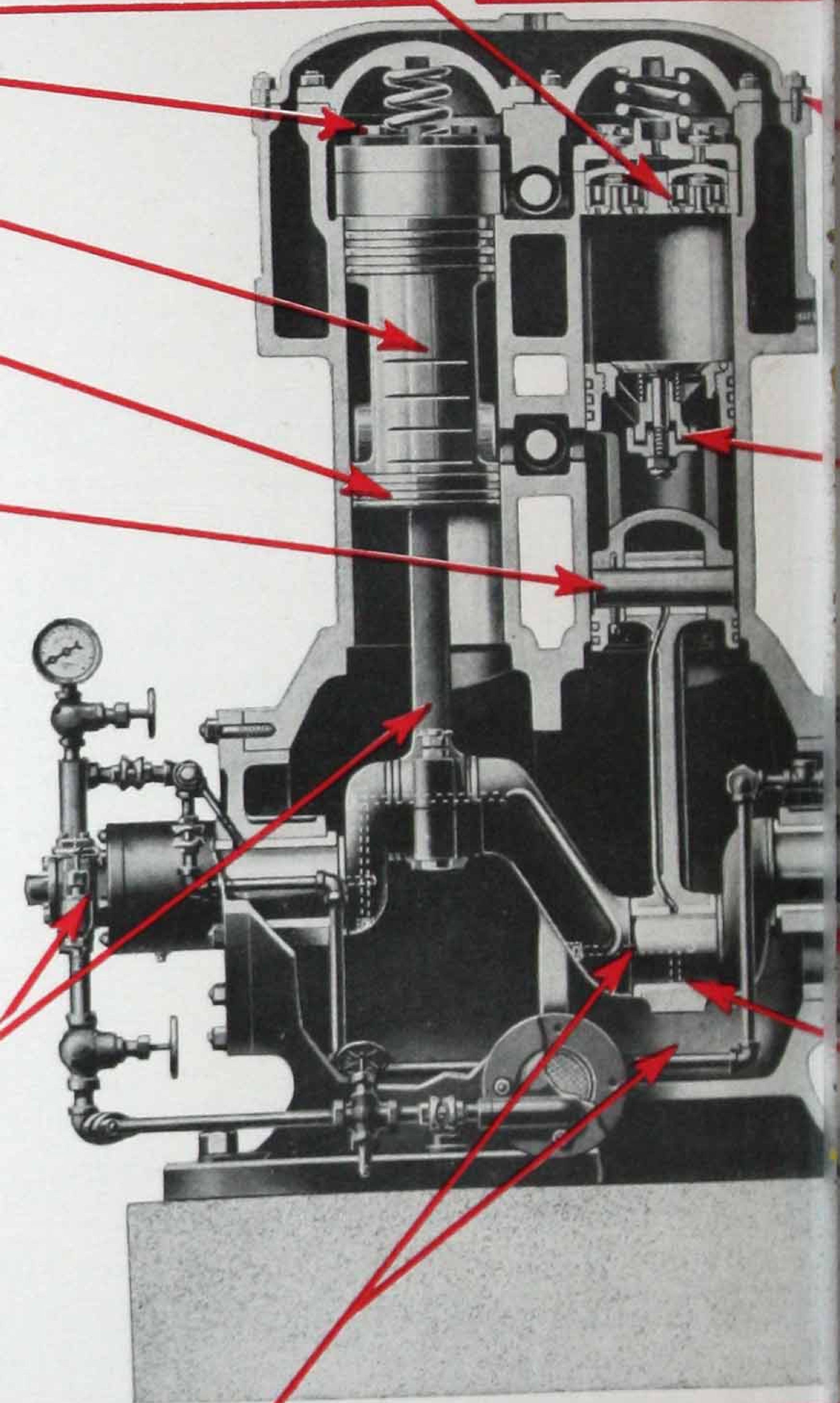
B—Pistons ground to size and made unusually long: suction ports uncovered throughout stroke. Ample thrust surface opposite piston pins. 9 by 9, 10 by 10 and 12 by 12 machines have babitted pistons and rings.

H—Plate discharge valves, developed especially for this service. Light moving parts: quiet, tight and reliable. Larger cylinders have multiple valves. Heat-treated ring plates give long useful life.

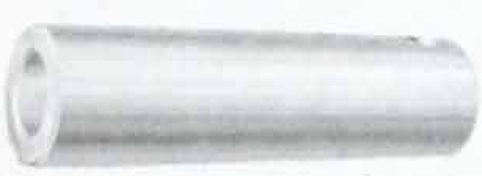
I—Large suction scale
metal, in bypass man
moved for cleaning, b
shut-off valves.



C—Two special scraper rings remove excess oil through drain holes in piston. Three pressure rings at top. Note arrangement of oil grooves in piston shown at left.

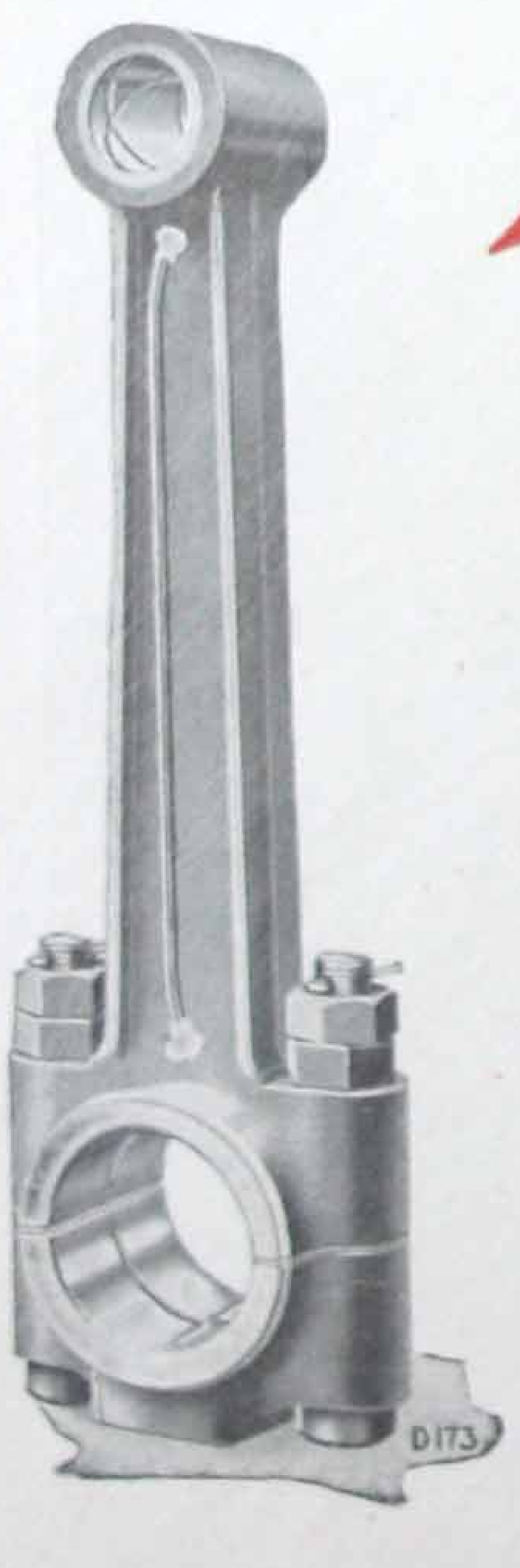


D—Case-hardened steel piston pins, accurately ground to fit cast iron bushings. Larger machines have hollow pins. Note oil hole in bushing. Lubrication is extra thorough.



E—Superior workmanship and very best materials insure long life of machines. Castings sand blasted and properly aged. Rigid inspection and tests given all parts, which are made interchangeable. Over 63 years' refrigerating experience built into every compressor. Check the details of these advanced machines against any others. Fully guaranteed.

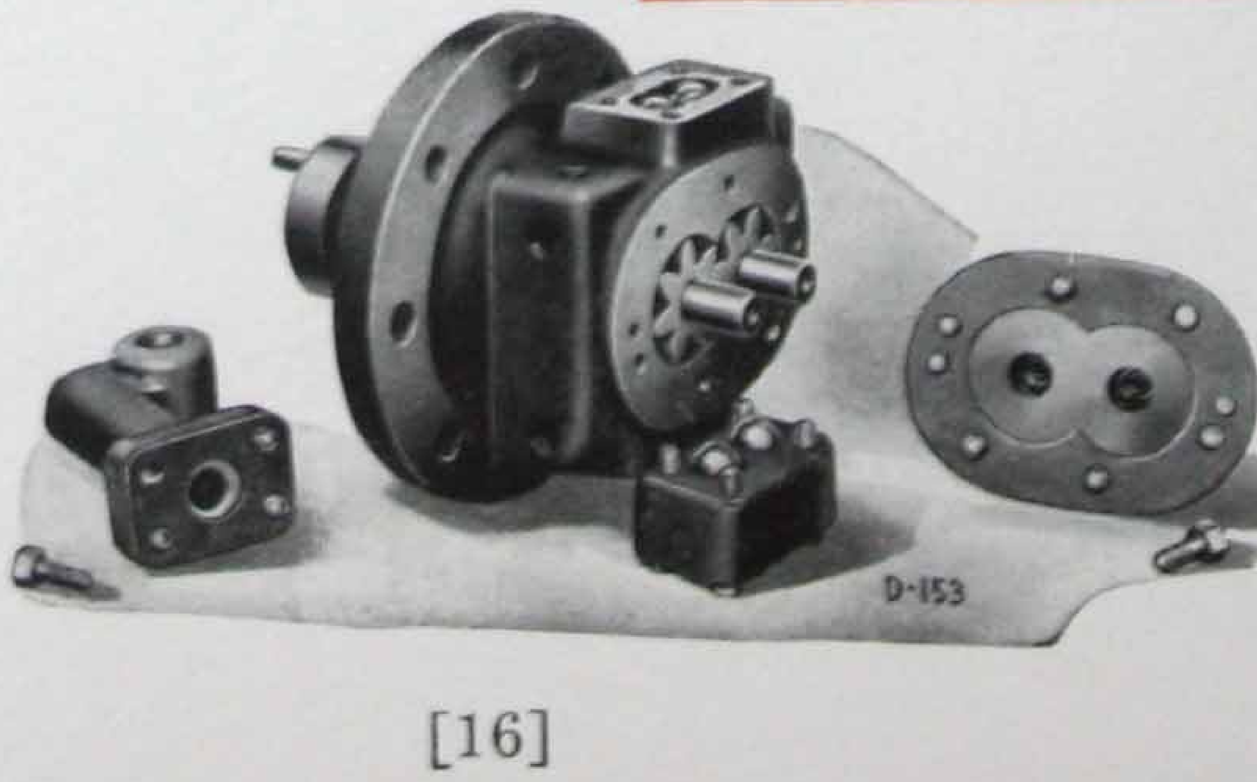
F—Drop-forged steel connecting rods, made extra long to lessen side thrust on pistons. Crank bearings are marine type, with shims for adjustment. Chrome-vanadium steel bolts secured by lock nuts and pins. H-section rod gives maximum stiffness.

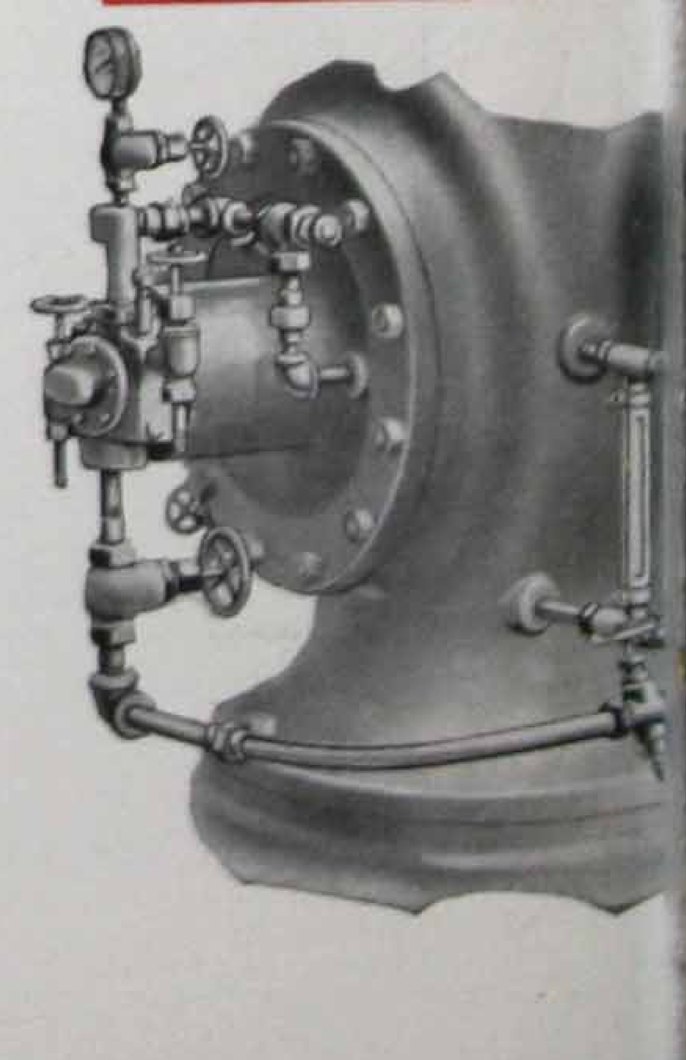


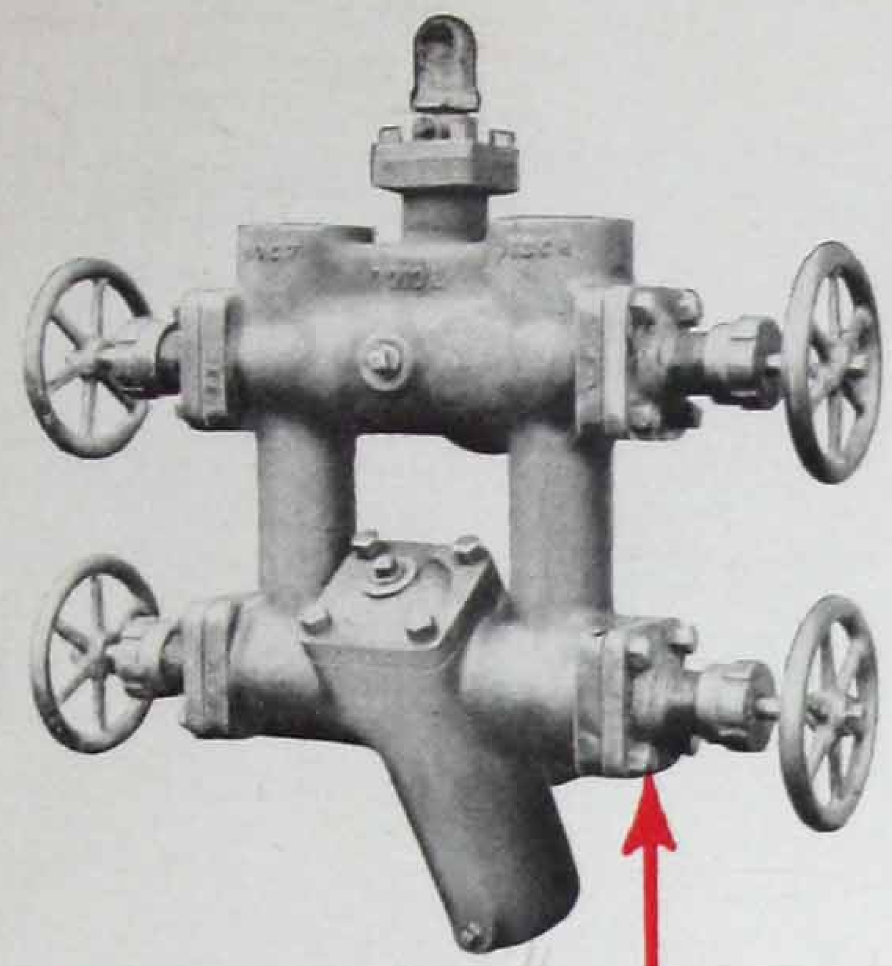
G—Oiling system features include removable strainer, pump, gauge, relief valve, and piping for oil at two pressures—adustable spring relief valve passes oil to stuffing box. Gear pump operates in either direction and additional oil can be charged into machine while running. Screen in base of crankcase is quickly cleaned.

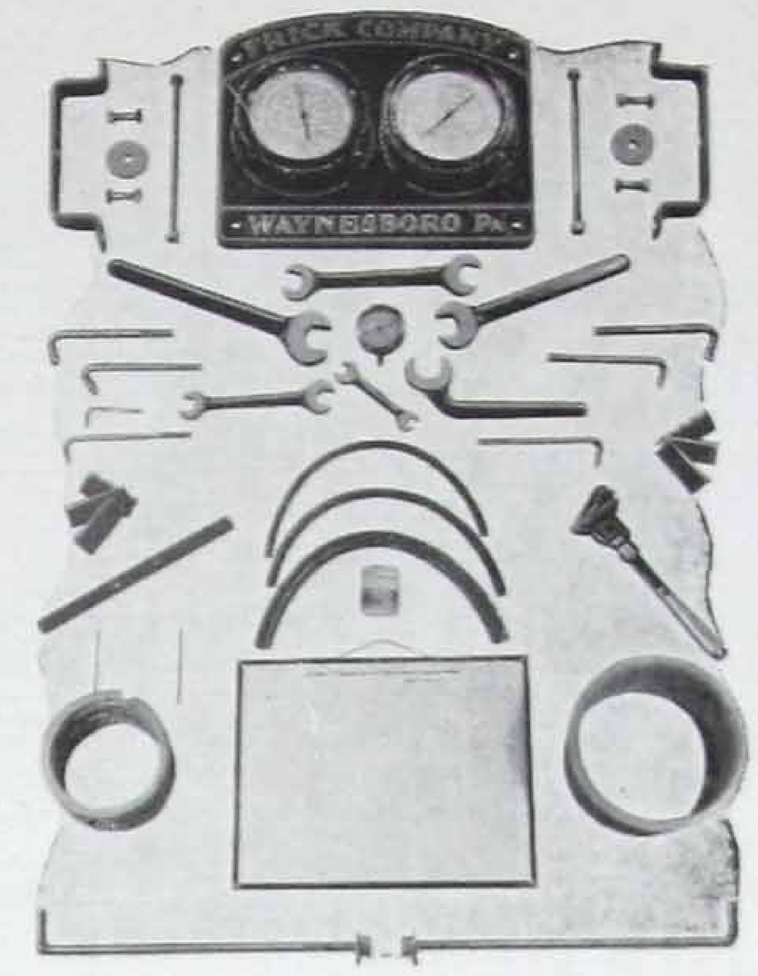
K—Force-feed oiling system gives positive automatic lubrication to bearings, cranks, wrist pins and stuffing box. Splash lubrication also maintained in crankcase. Faster running machines have mechanical sight-feed lubricator delivering oil to suction and to cylinder walls.

L—Greater weight, stre
ity. One-piece alignme
ders and crankcase on
the 4-cylinder machine
der walls, extra thick.







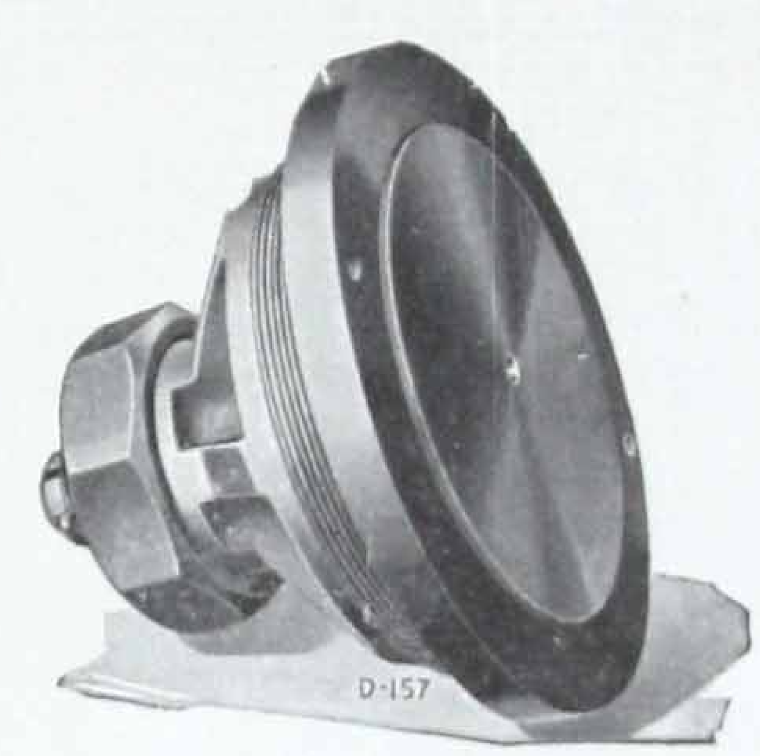


N—Standard equipment supplied with Frick compressors includes two ammonia gauges mounted on a metal board, packing for the stuffing box, set of wrenches and tools, foundation bolts and wedges, hose for drawing in oil, enameled chart of operating instructions, piston ring guide, and erecting drawings. A template is furnished for setting the anchor bolts on machines without a sub-base.

n, of Monel
Easily re-
between the

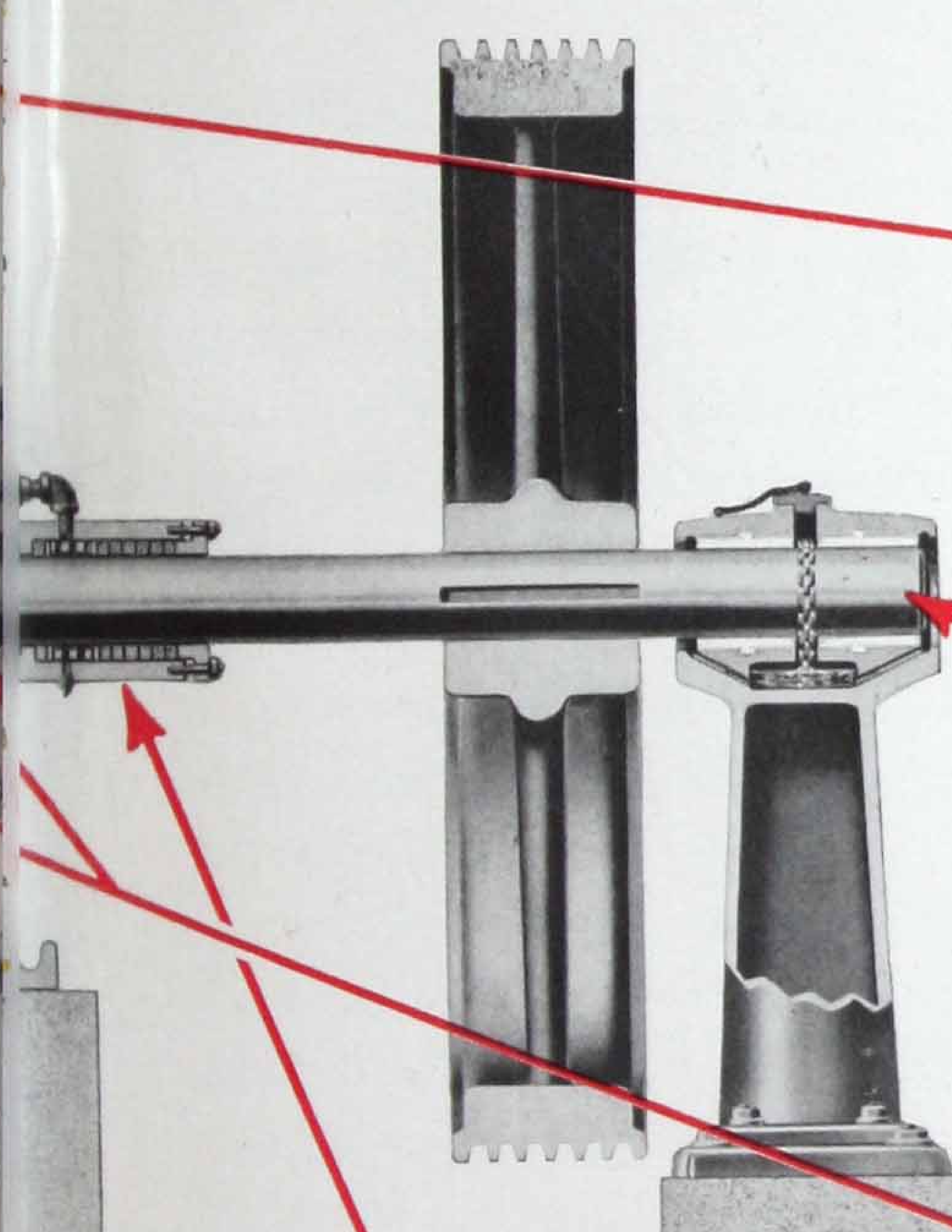
J—Full-size bypass connections in one-piece manifold. Frick patented tight-closing control valves arranged in simple square pattern, with safety relief valve above and suction screen below. Same size large pipe openings for suction and discharge. Automatic bypass furnished when desired.

O—Complete service—design, manufacture, sales, erection, test and maintenance—by a world-wide organization of refrigerating engineers. Offices in over 175 cities. One responsibility. Full line of ammonia, carbon dioxide and low pressure refrigerating machines makes our recommendations unbiased. Both vertical enclosed and combined unit types of machines.

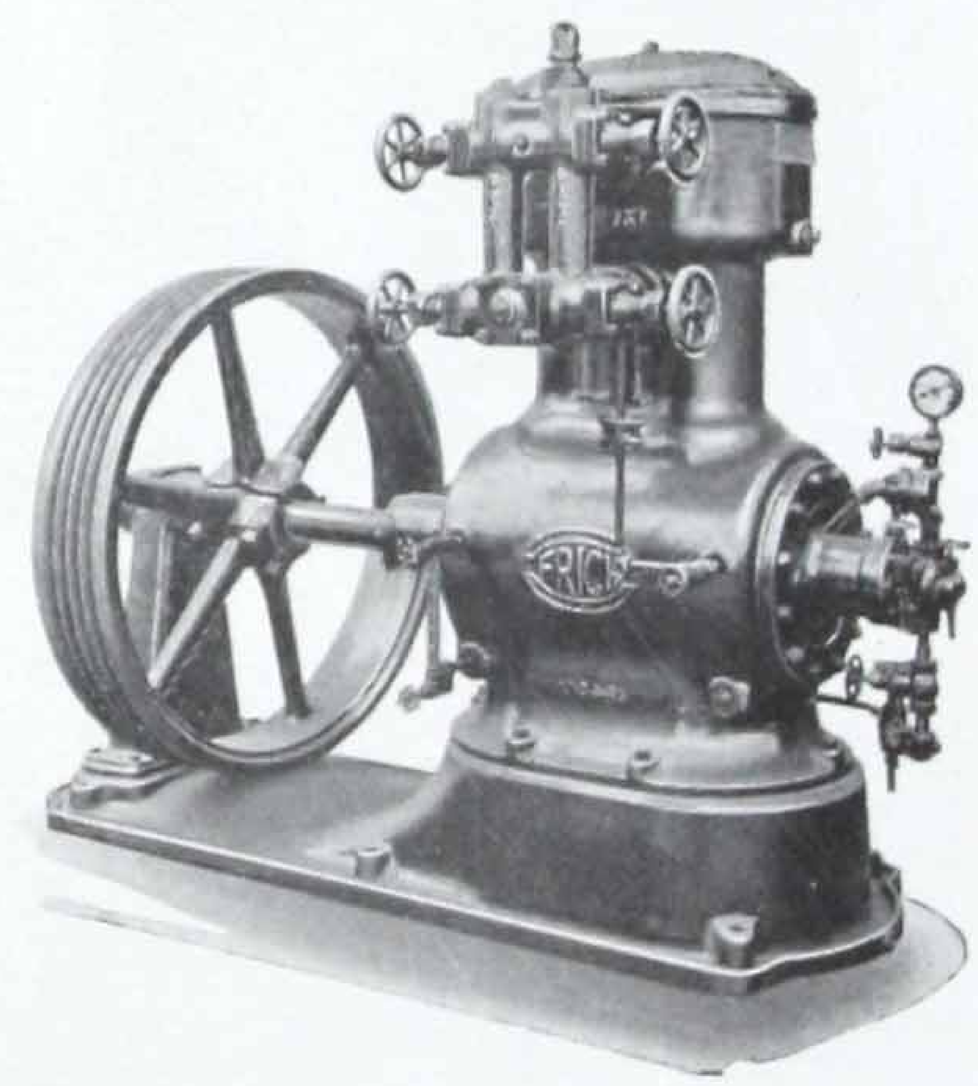


U—Section through standard Frick enclosed-type ammonia compressor.

P—Water jacket entirely covers cylinder heads, keeping them cool. Cover of jacket made removable to permit cleaning of mud or scale deposited by the water. Two water inlets; outlet at top.

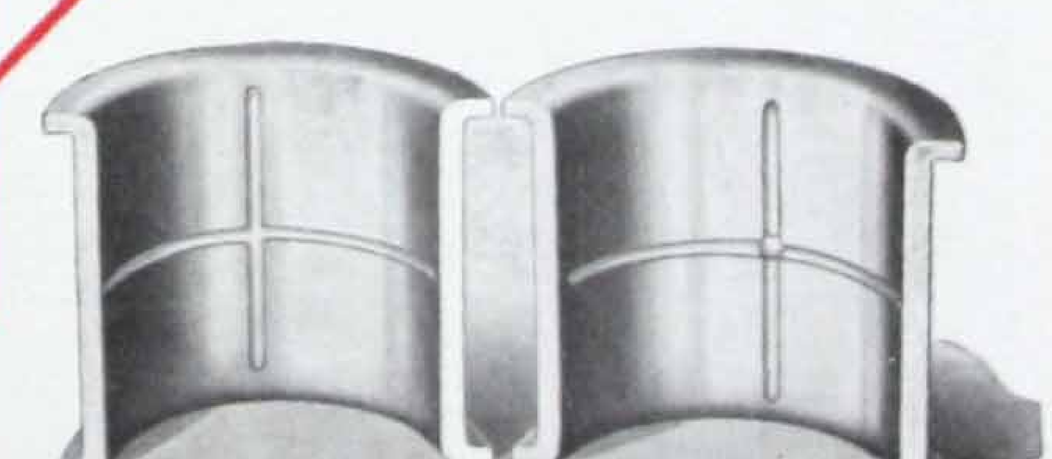


Q—Suction valve is floated by spring and motion is cushioned by dashpot. Valve cages are threaded, screwed into piston, and securely pinned. (No tap screws to work loose.) Multiple suction valves on 6 by 6 and larger machines. Adequate valve opening and quiet action on all sizes. A superior design for a superior machine.



R—Chain-oiled outboard bearing beyond wheel supports weight of fly-wheel and pull of belt. Base frame, heavily ribbed, supplied on compressors of smaller sizes. Bearing pedestal is long enough to permit removal of wheel.

S—Perfectly adapted to any type of drive: flat or V-belt, direct-connected synchronous motor, steam, oil, or gas engine, tandem coupled, or special drives. Machines built with dual-pressure cylinders or capacity controls when desired.



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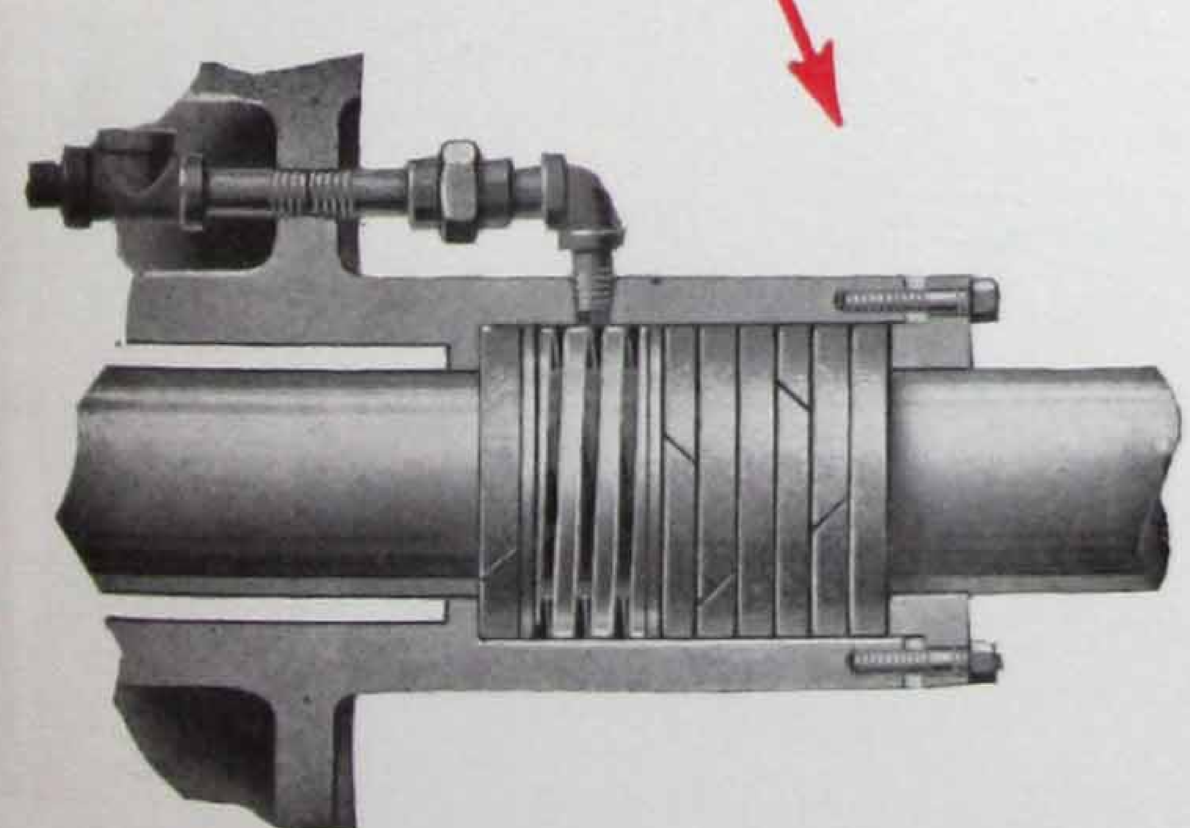
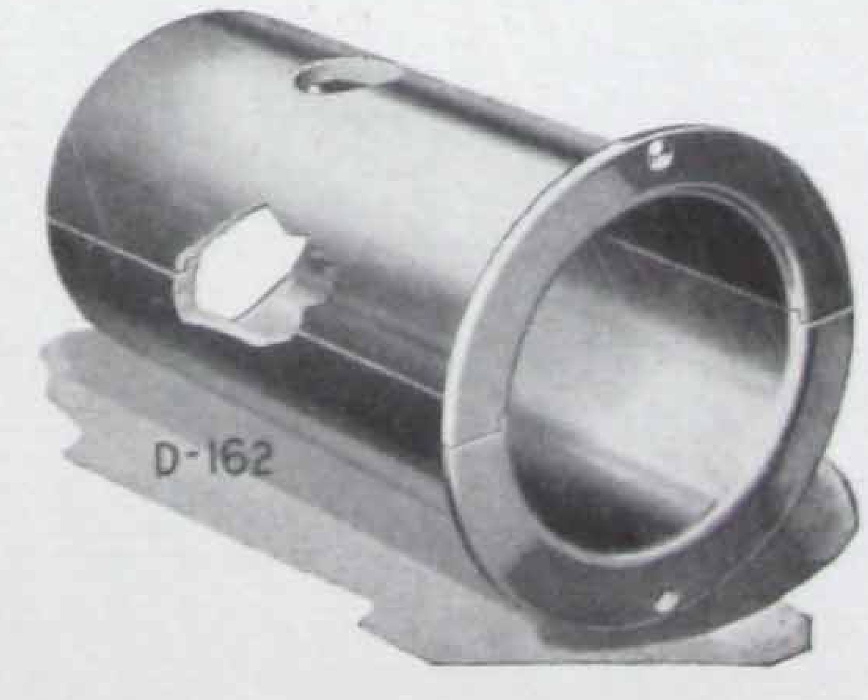
M—Double-length stuffing box with self-adjusting spring serving also as oil lantern. Sealed with oil under low pressure. Frick patented Flexo-Seal available when desired: standard on 3″, 4″ and 5″ sizes.

T—Die-cast bearings of best grade heavy-duty babbitt, surface hardened against wear. Split sleeves make renewal easy. Big-diameter shafts and generous bearing surfaces.





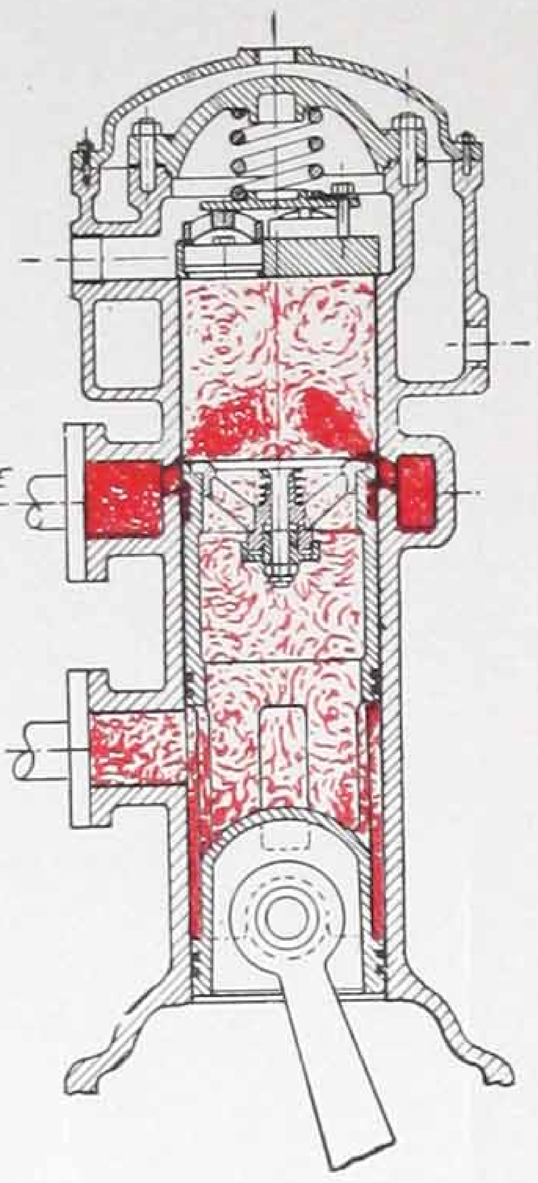


Fig. 75—In a Dual-Pressure Machine, Suction Gas at the Medium Pressure Raises to its Own Level the Gas Already in the Cylinder.

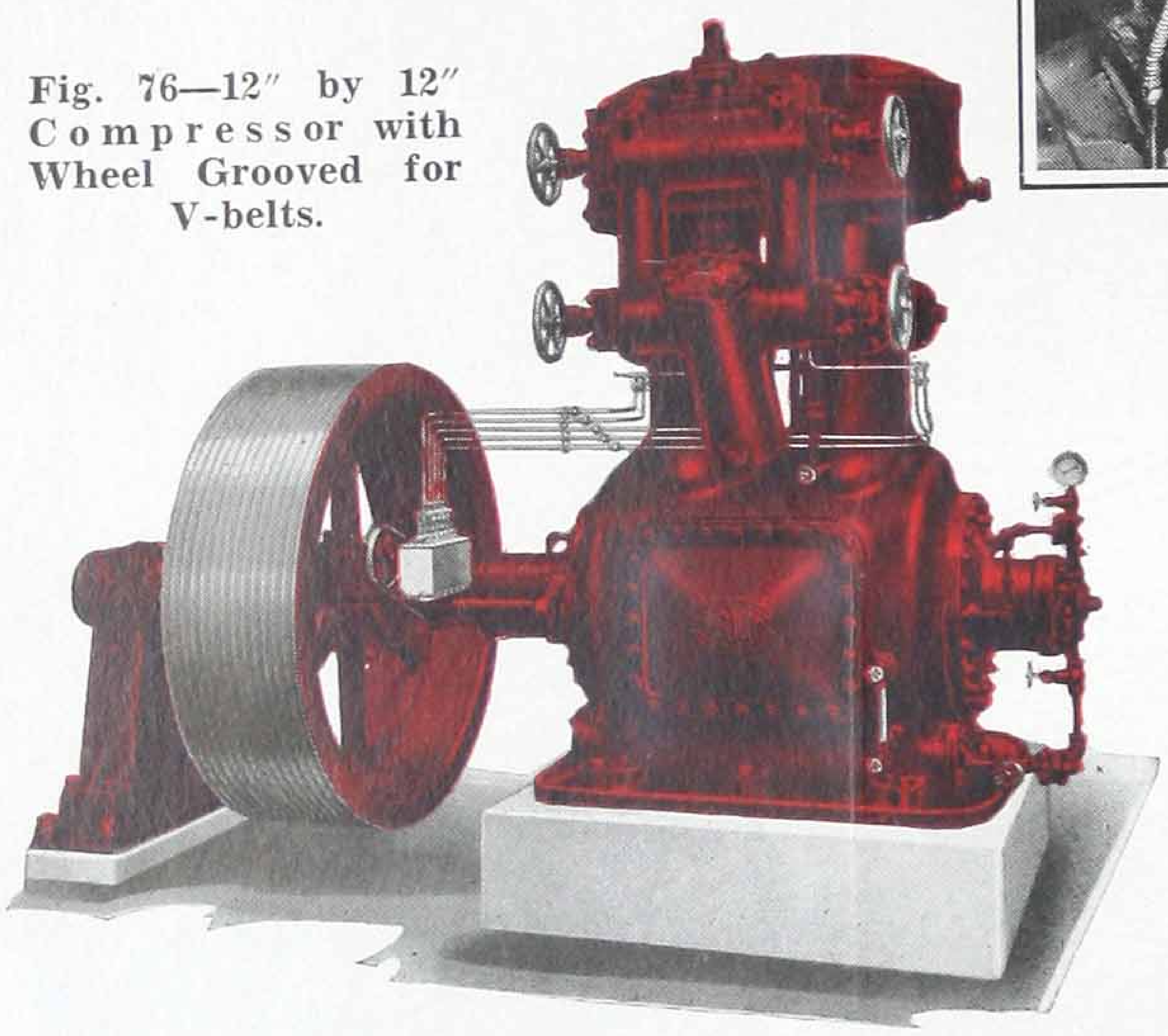


Fig. 76—12″ by 12″ Compressor with Wheel Grooved for V-belts.

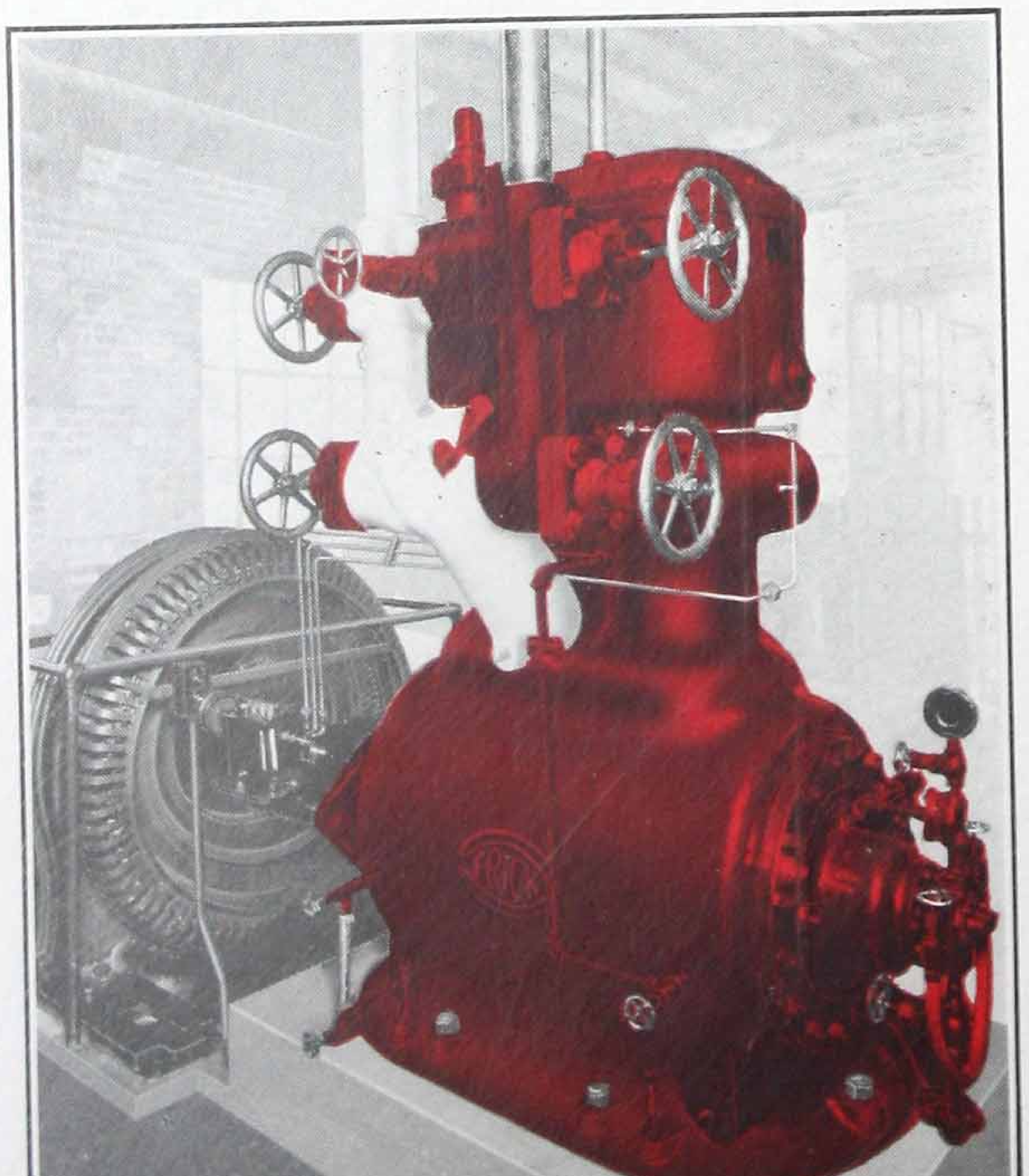


Fig. 77—10″ by 10″ Compressor with Synchronous Motor Drive at the Jos. Stark Ice Plant, Baltimore, Md.

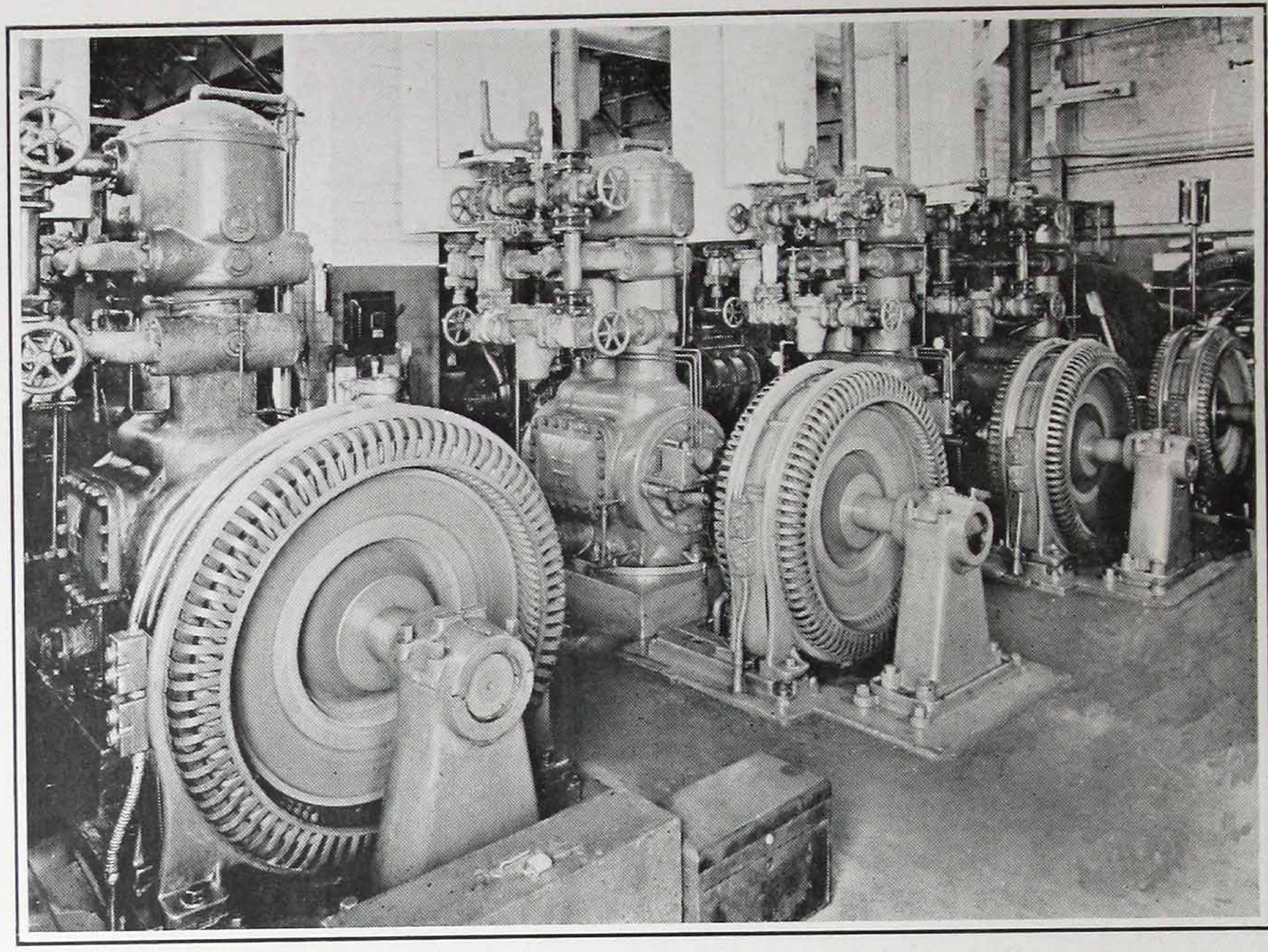


Fig. 78—Four Dual-pressure Machines in the Modern Ice Plant at the Atlantic Co., Jacksonville, Fla.

Ice-making plants and others often find that power can be saved by operating at two distinct suction pressures. The water to be frozen and the liquid ammonia can both be precooled to advantage at high suction pressure. In this case either separate machines, or dual-effort compressors arranged with extra-long pistons and double-ported cylinders, as shown above, are used.

Capacity controls can be furnished on 6 by 6 machines and larger: these are either adjustable (Fig. 79) or reduce the capacity of each cylinder 50 per cent when the control valve opens a port, about half way up the stroke, which bypasses the gas back to the suction. (Fig. 92). This last is the "standard" design of machines having capacity controls.

See Bulletin 112 for further details on Frick enclosed ammonia compressors.

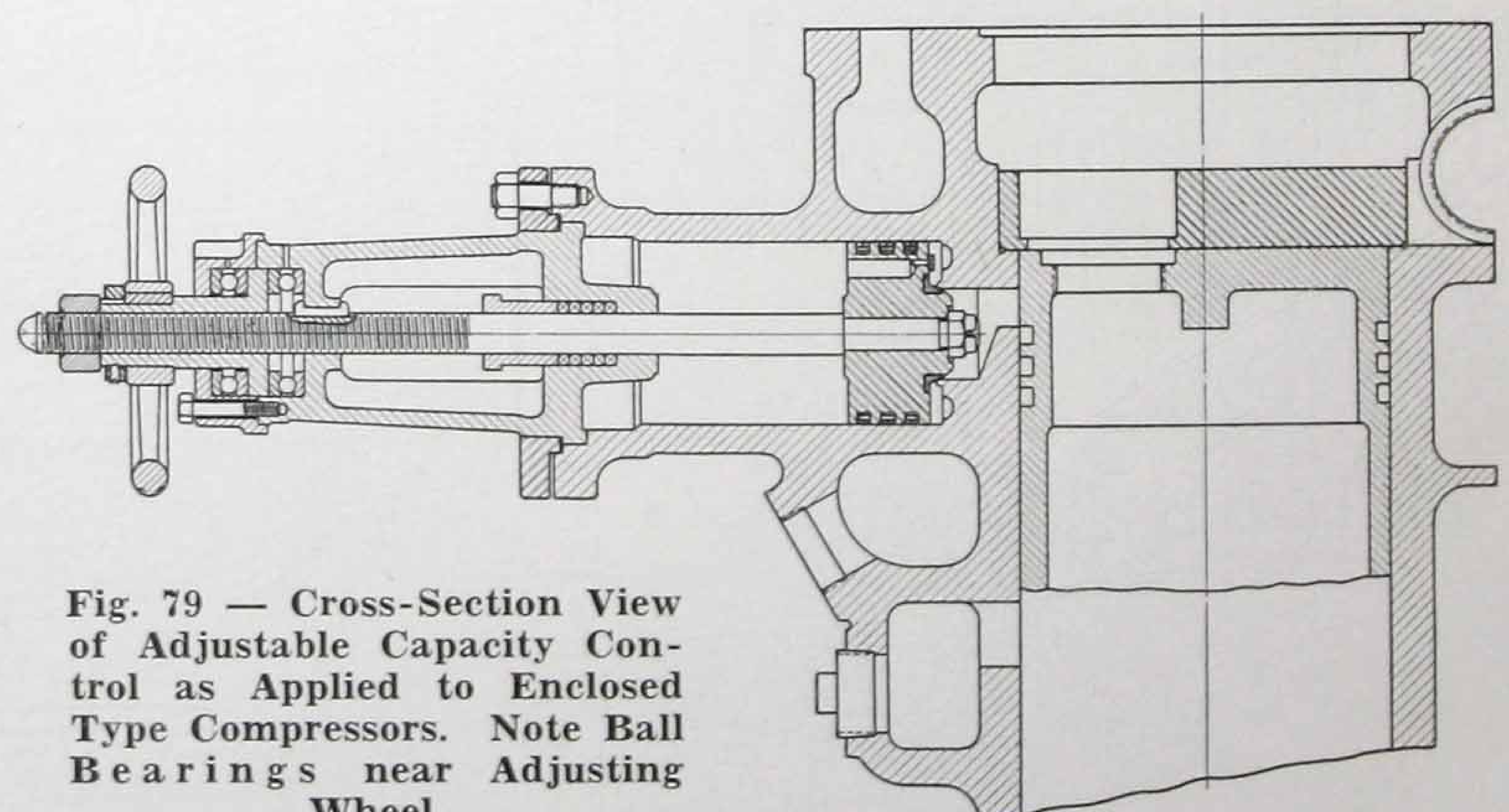


Fig. 79 — Cross-Section View of Adjustable Capacity Control as Applied to Enclosed Type Compressors. Note Ball Bearings near Adjusting Wheel.

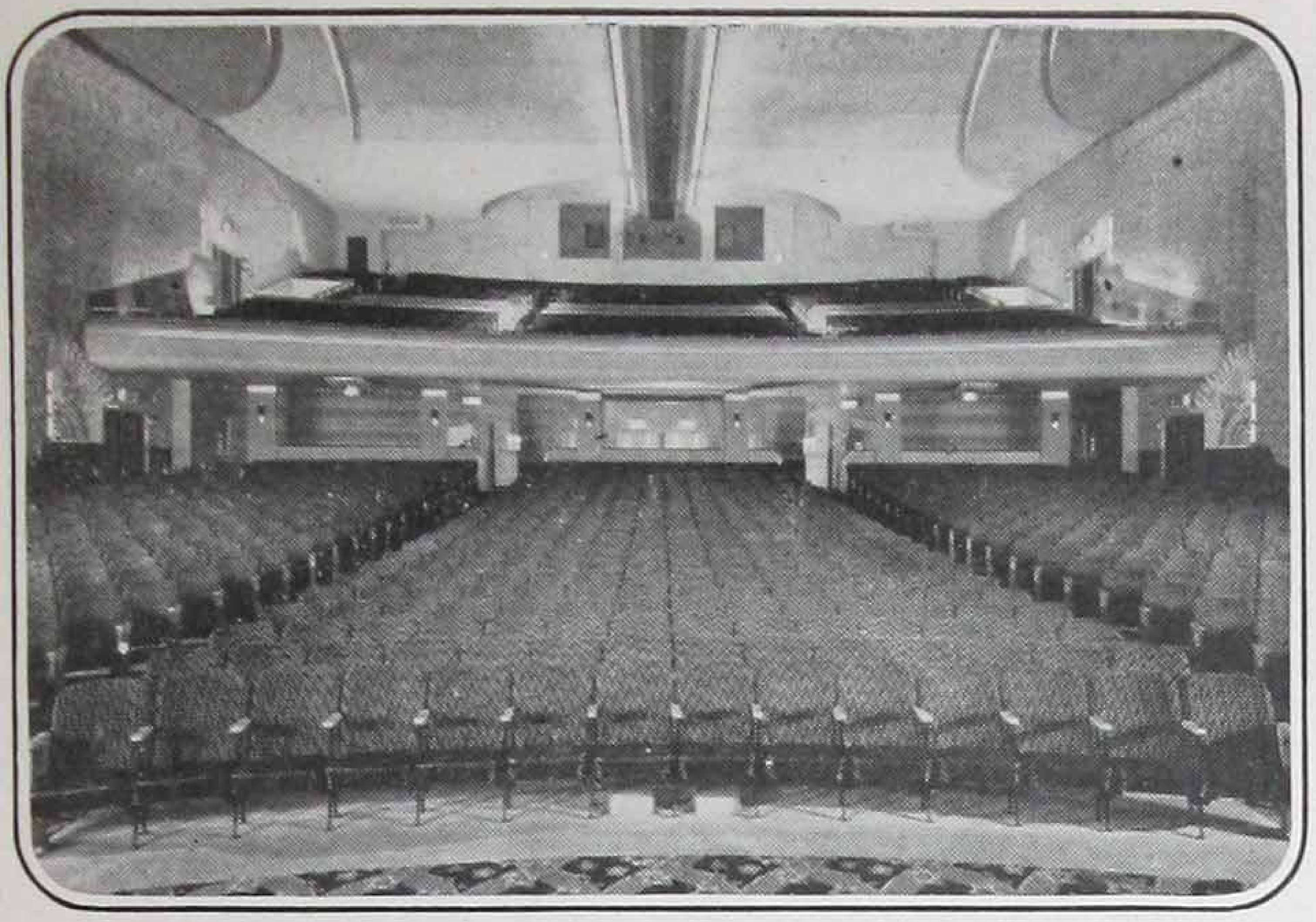


Fig. 80—The Penn Theatre in Washington, D. C., Seats 1500, and is Equipped with two 8¾ by 6 Frick Freon-12 Machines for Air Conditioning.

Fig. 81—The Phoenix Insurance Co. Air Conditions Its Home Office Building at Hartford, Conn., with Three Frick 7¾ by 5 Compressors, Handling Freon-12.

Freon-12 and Ammonia Booster Compressors

These machines are of similar design, whether used with low-pressure refrigerants such as Freon-12 and methyl chloride, on air conditioning work, or in handling ammonia at low pressures and low temperatures in two-stage or booster service. The cylinder heads are cooled by fins on all except the largest sizes, which have water jackets; booster compressors may have water or ammonia jackets.

These compressors are arranged particularly for handling the larger gas volumes encountered at low operating pressures; the problems of oil separation and adequate lubrication, self-adjusting shaft seal, ample valve passages, and similar details, have been successfully solved. With low-pressure refrigerants the lubricating oil travels through the system and must be recovered upon returning to the compressor. Frick machines have the force-feed oil pump in the base of the crankcase, where the oil runs into it by gravity, assuring positive feed. A Cuno self-cleaning oil filter is provided.

The suction as well as the discharge valves are of the ring-plate type, providing extra large gas passages, and other details of construction have been similarly refined. See complete description in Bulletins 508 and 516.

Sizes begin with the 5¾″ by 4″ and 7¾″ by 5″ machines, which have overhung belt wheels; the next two sizes, 8¾″ by 6″ and 11½″ by 8″, have outboard bearings and finned cylinder heads; the larger sizes, 13¼″ by 9″ to 17¾″ by 12″, have outboard

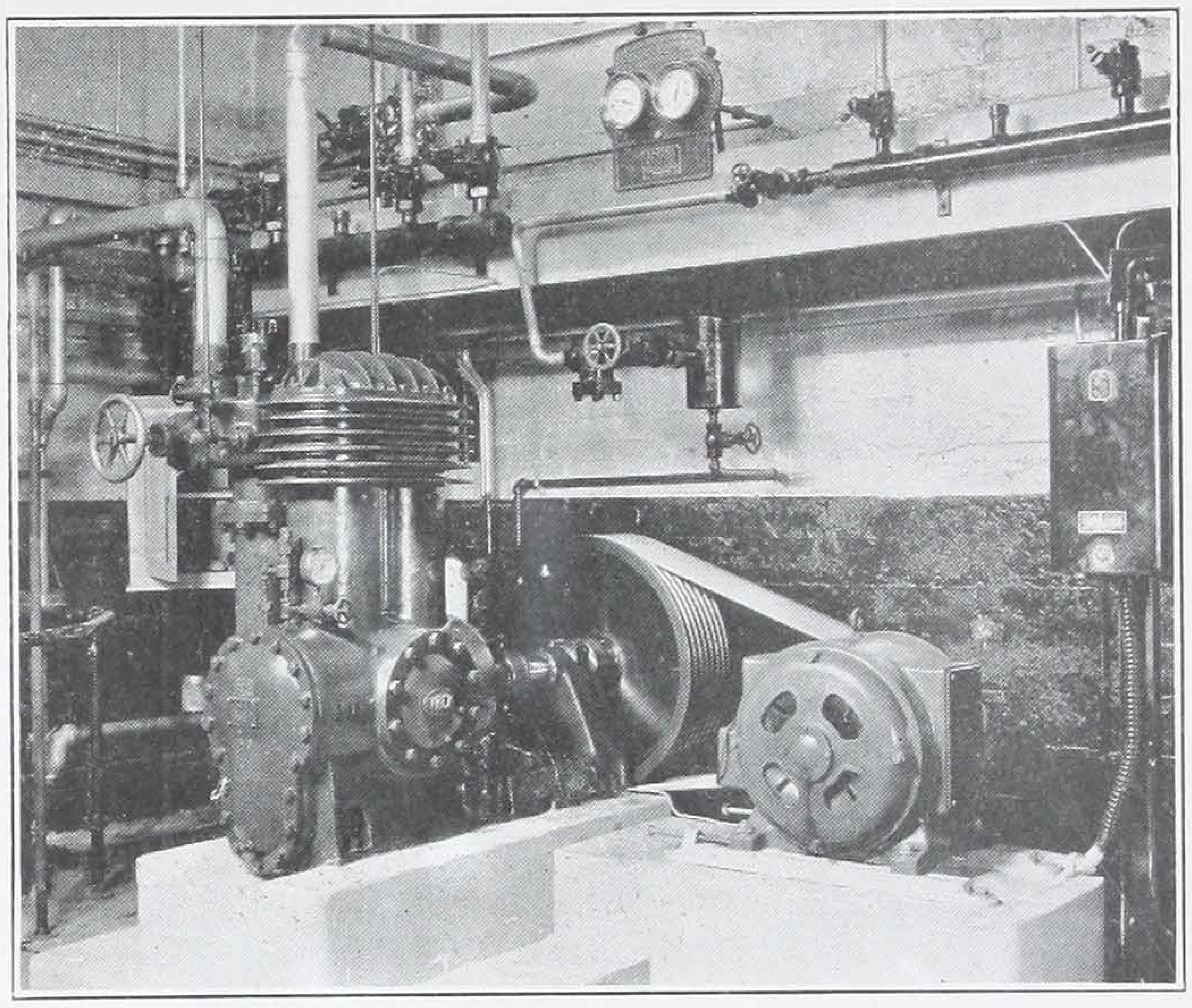


Fig. 82—7¾ by 5 Compressor used in the Year 'Round Air Conditioning System of Chas. E. Frosst & Co., Pharmaceutical Chemists at Westmount, Province of Quebec, Canada.

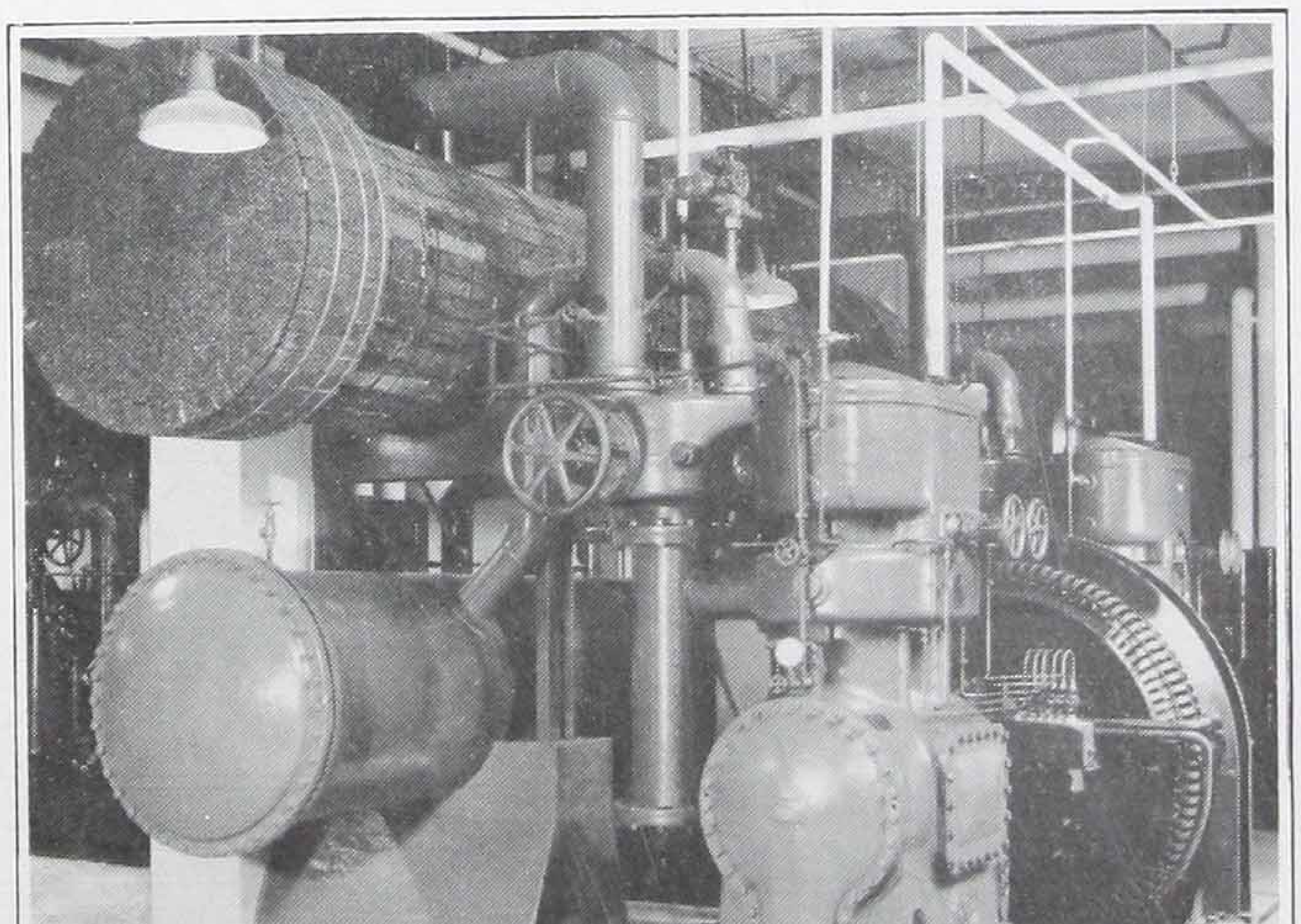


Fig. 83—One of Two Sets of Frick 15 by 10 Duplex Compressors, Condensers and Water Coolers, which Air Condition the H.O.L.C. Building, Washington, D. C.

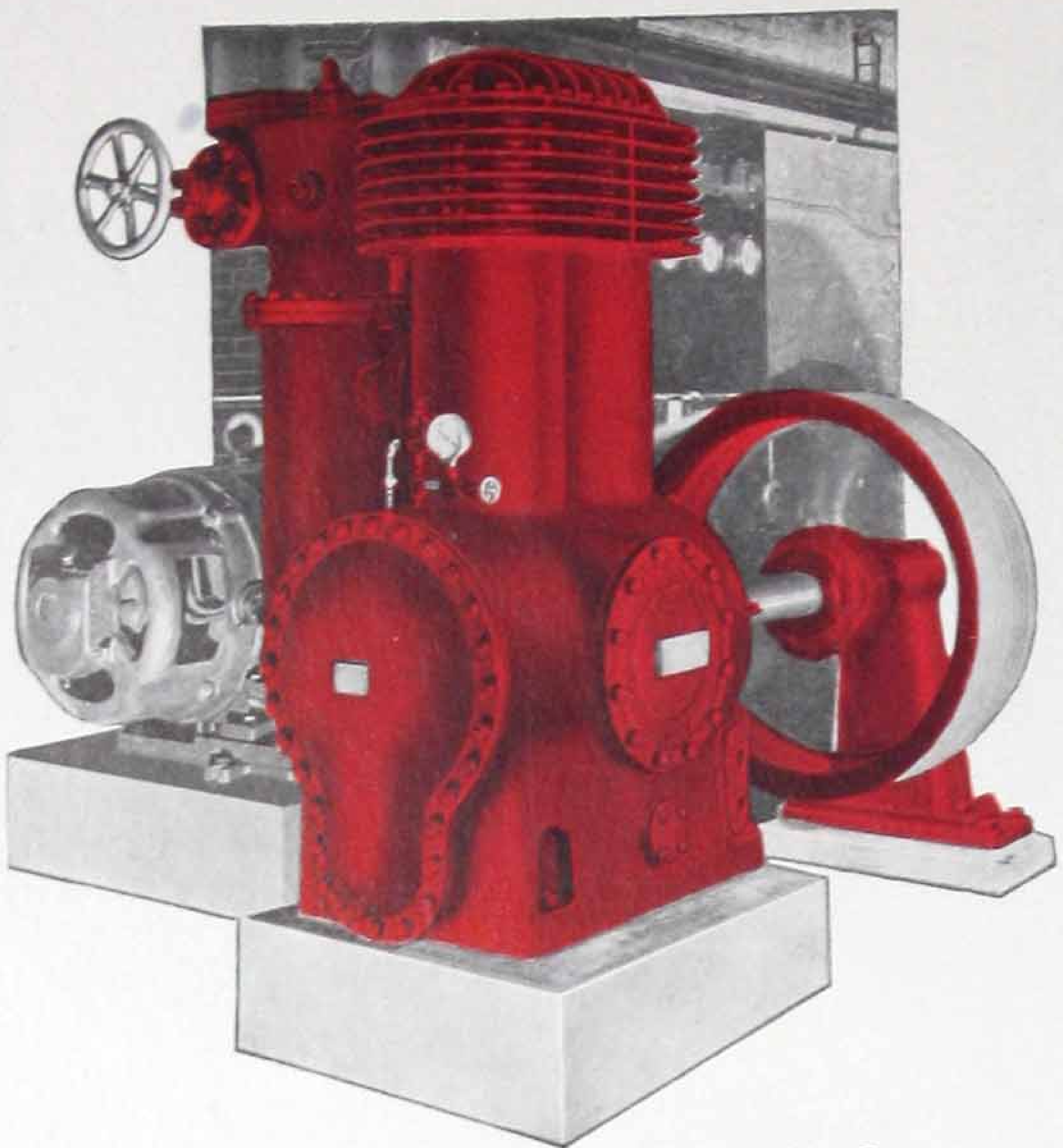


Fig. 84—One of Several Frick Freon-12 Compressors Used for Air Conditioning the Hochschild-Kohn Department Store at Baltimore, Md.

Fig. 87—Four Frick 15 by 10 Compressors Air Condition the Administration Building of the Department of Agriculture, at Washington, D. C.

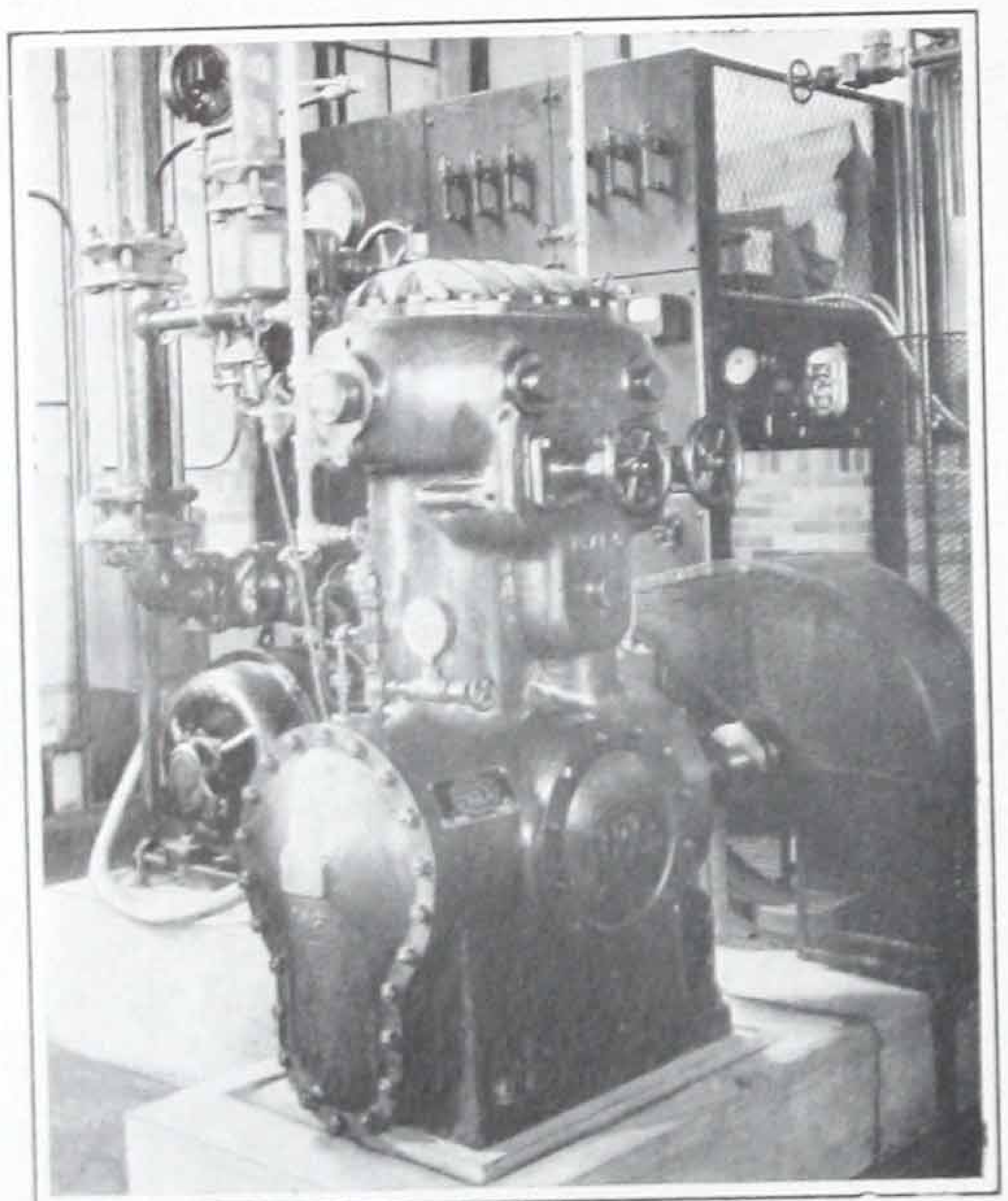


Fig. 85—8¾ by 6 Booster Compressor Handling Low-Temperature Ice Cream Making and Locker Plant Work. Note Jacketed Head.

bearings and water-jacketed heads. Four-cylinder machines of this same general design are described on page 21. Capacity controls are available on the 8¾″ by 6″ and larger sizes; each control valve, when opened, reduces the output of its particular cylinder by one-half. See Fig. 92. The controls can be arranged to operate automatically, by means of oil pressure when desired, as shown in Fig. 89.

The Patented Flexo-Seal is under constant lubrication, the small amount of heat generated being carried away by a water pipe imbedded in the metal of the face. A thin flexible steel sealing ring is pressed against the bearing face; back of this ring are compressible sealing rings arranged to prevent leakage both at the shaft end and at the steel ring. The soft rings are kept under pressure by springs and by the gas under crankcase pressure. All the parts of the Flexo-Seal revolve with the shaft except the annular bearing face, which replaces the gland of the standard stuffing-box. This seal compensates for the minute variations in contact encountered while the machine is in motion, and has proved so satisfactory that it is now standard equipment on many of our ammonia machines, which at times operate under much higher crankcase pressures.

Hundreds of the finest air conditioning installations use these Frick Freon-12 compressors, and they are employed with equal efficiency on low-temperature quick-freezing work.

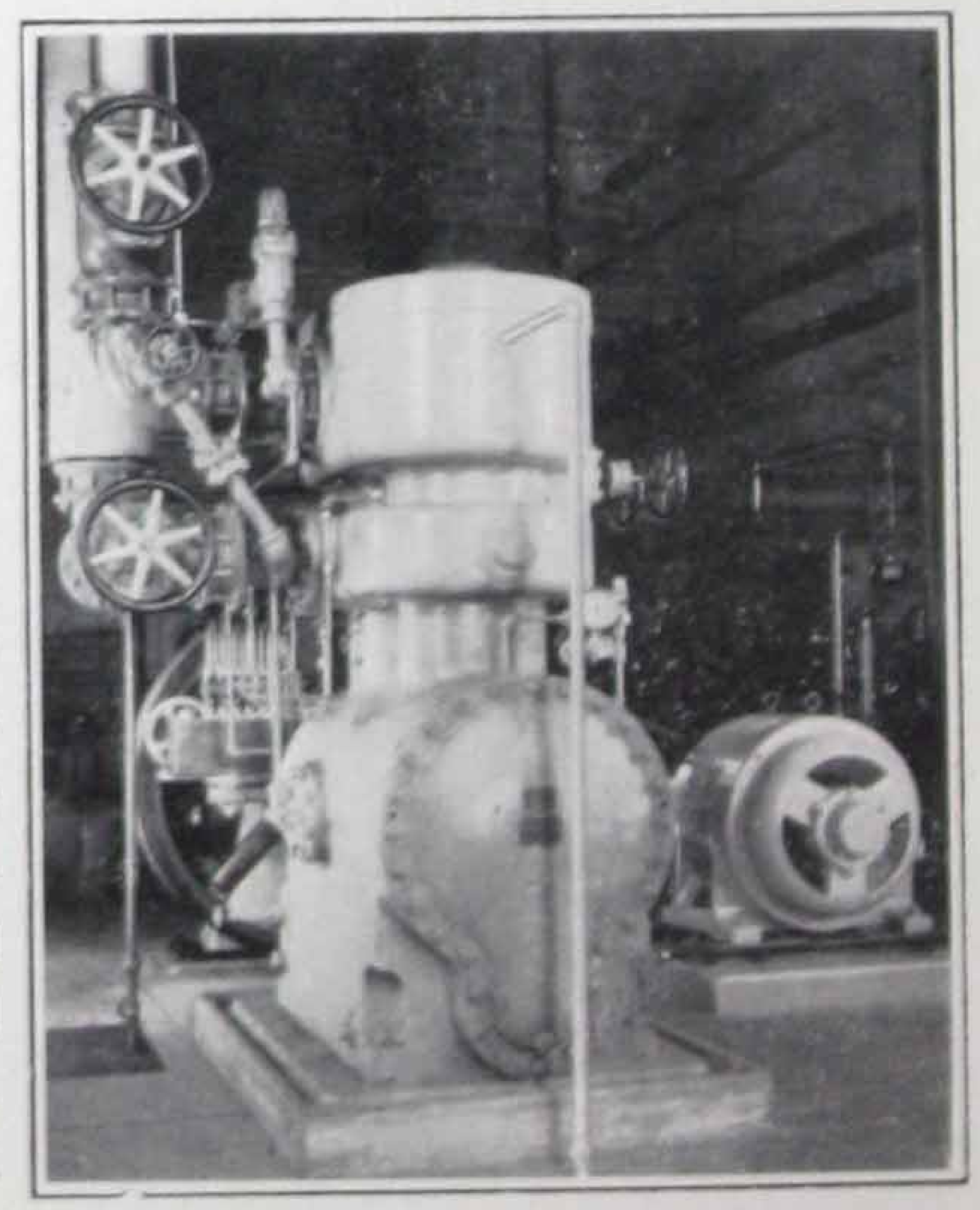


Fig. 88—13¼″ by 9″ Booster Machine Which Provided Larger Freezing Capacity and Improved Quality of Products for the Merchants Ice and Cold Storage Co., San Francisco.

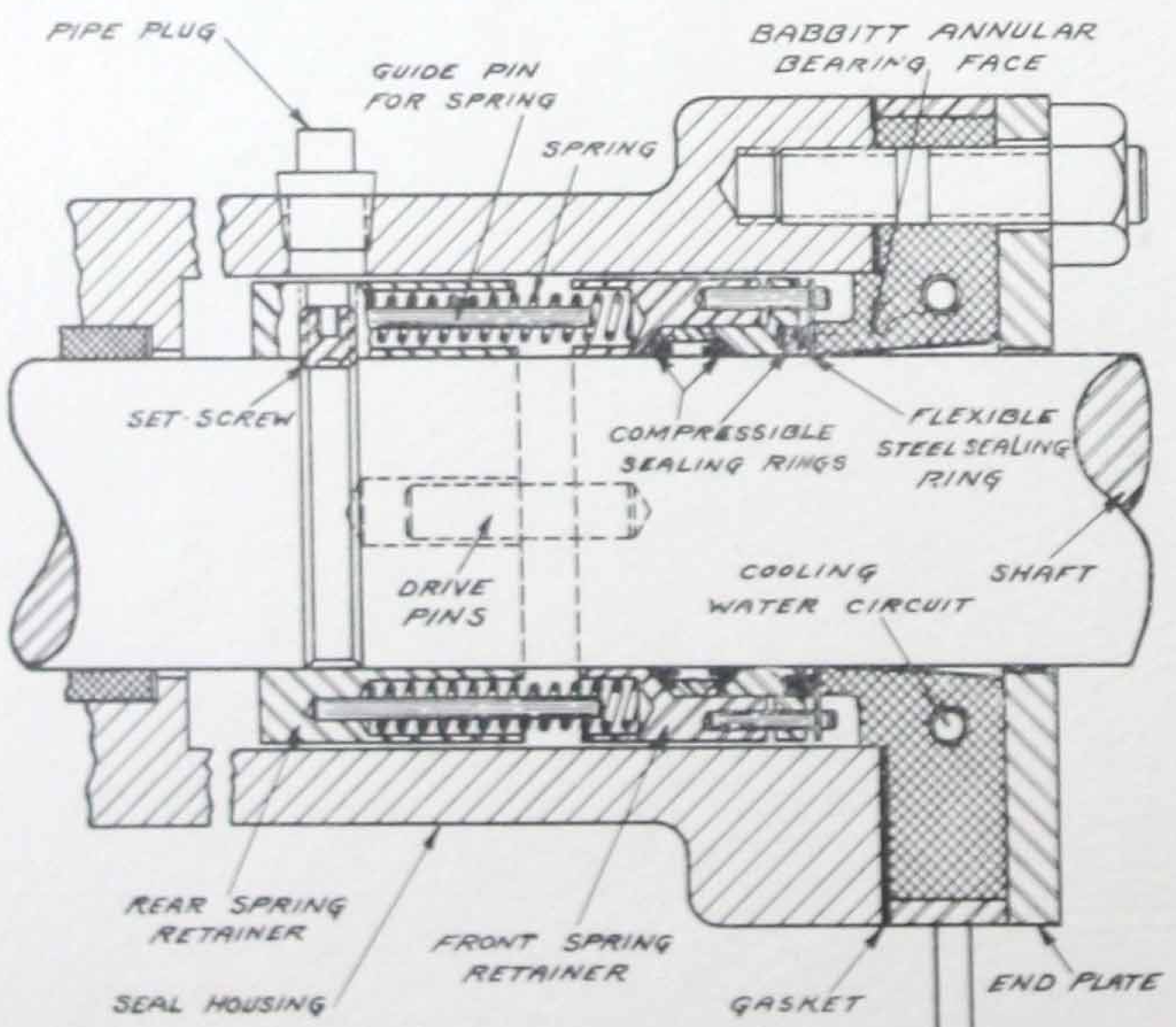


Fig. 86—Section Showing Design of the Patented Frick Flexo-Seal, with the Names of the Parts.

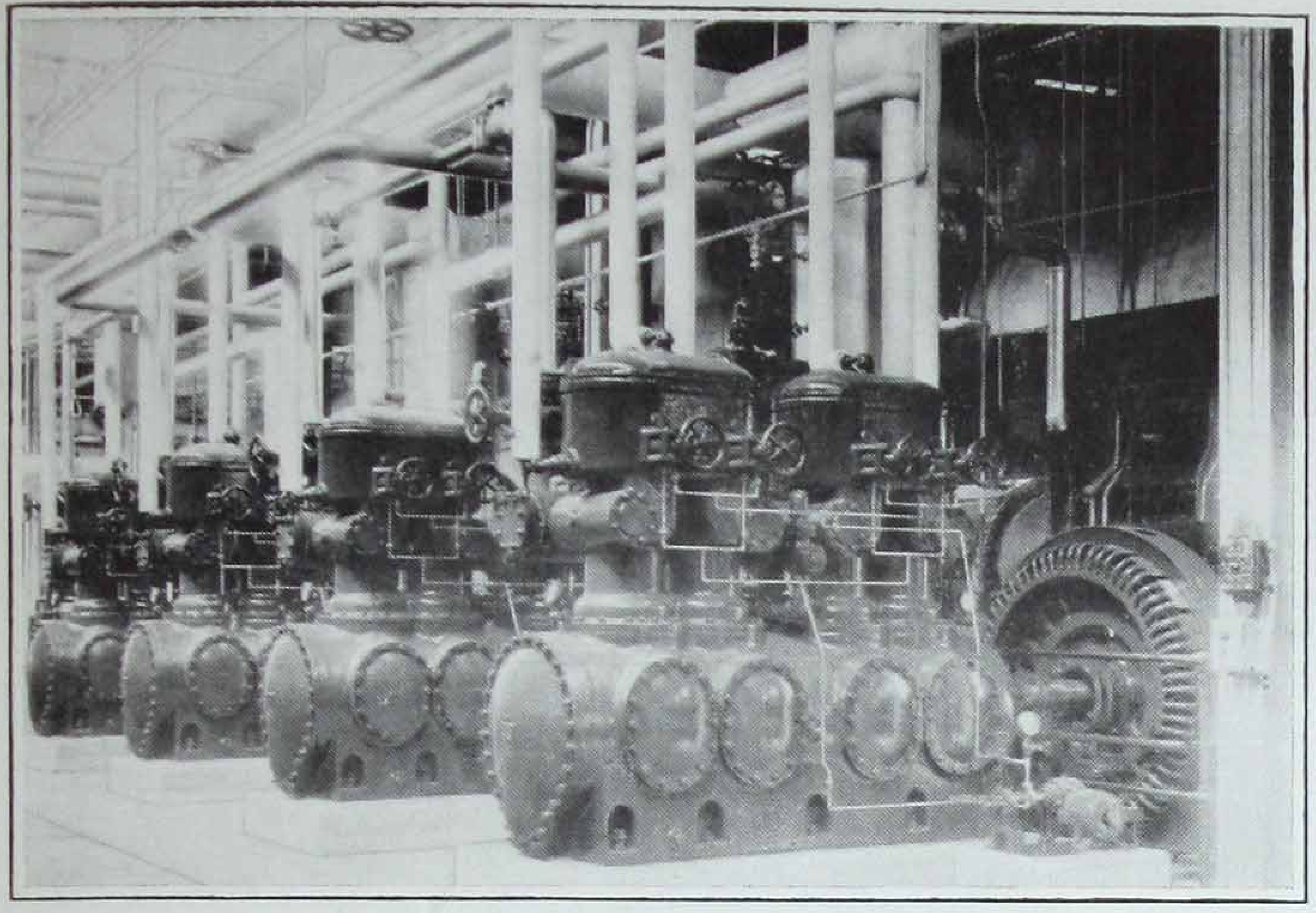


Fig. 89—11″ by 10″ Ammonia Compressors Supplying 750 Tons Refrigeration for the American Viscose Corp. Note Automatic Capacity Controls, Oil-operated.

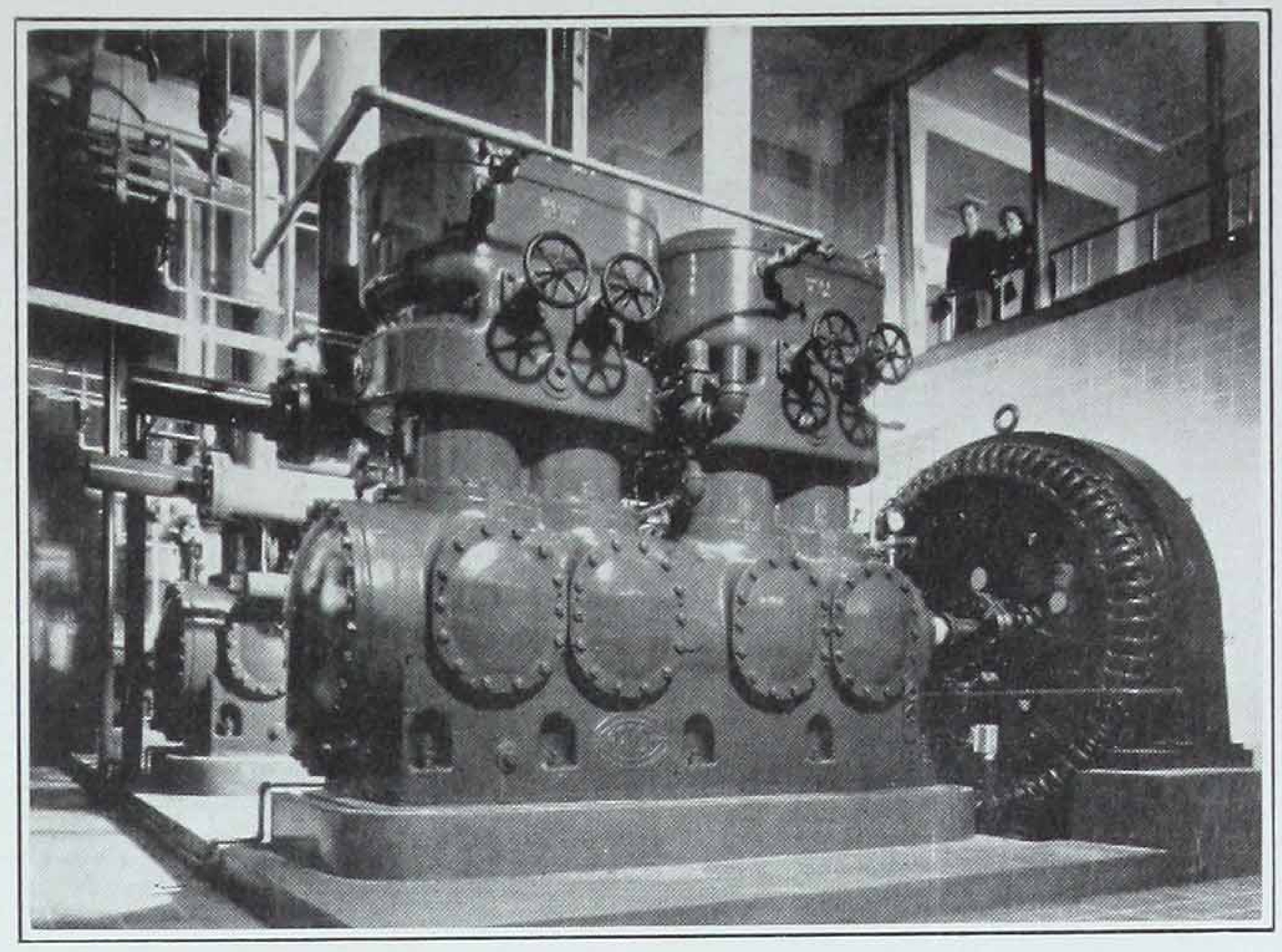


Fig. 91—Two 4-Cylinder 15″ by 10″ Freon-12 Machines at the $1,500,000 Bankers Life Building, Des Moines, Iowa, which is Air Conditioned Throughout.

Large Four-cylinder Compressors

Similar in their general features to the standard enclosed machines described on pages 14 to 18, these 4-cylinder compressors are more heavily built, with crankshafts 6″ or 7″ in diameter, and with separable cylinders, cast in pairs.

They are made in six sizes: 10″ by 10″, 11″ by 10″, 12″ by 12″, 14″ by 12″, 15″ by 10″ and 17¾″ by 12″ (bore and stroke). The two largest machines are designed for Freon-12 or ammonia booster service.

Each cylinder is fitted with a capacity control, the opening of which reduces its load by one half. Opening the control valves in succession lowers the total capacity of the machine in steps to 87½, 75, 62½, and 50 per cent.

The force-feed lubricating system, for the bearings and rods, is all enclosed: the oil pump, which has a Cuno self-cleaning filter, is driven by a roller chain from the end of the crankshaft. A 9-point mechanical lubricator feeds two points on each cylinder wall, and into the suction. See Bulletin 651 for complete details, sizes of parts of the machines, etc.

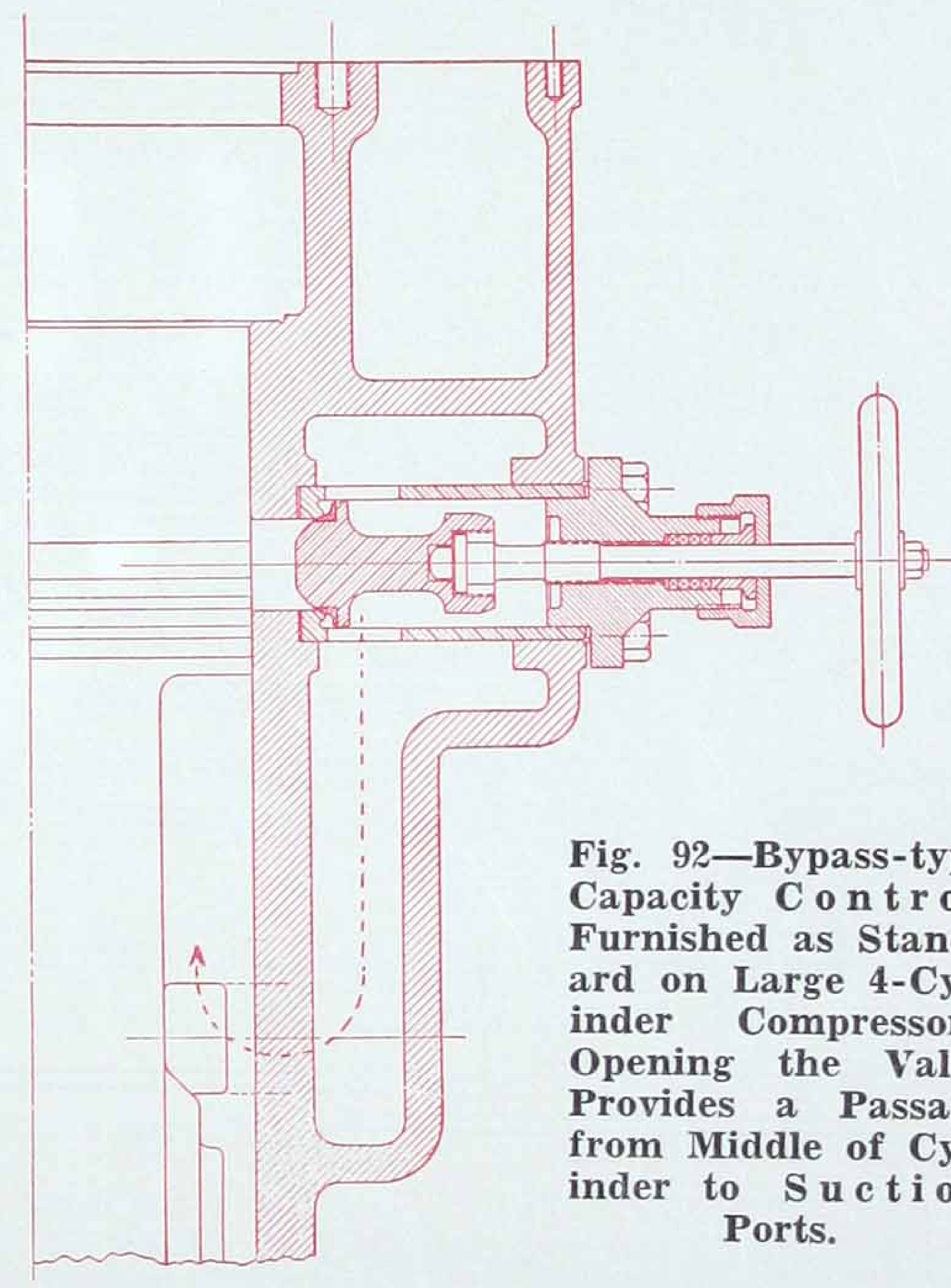


Fig. 92—Bypass-type Capacity Control, Furnished as Standard on Large 4-Cylinder Compressors. Opening the Valve Provides a Passage from Middle of Cylinder to Suction Ports.

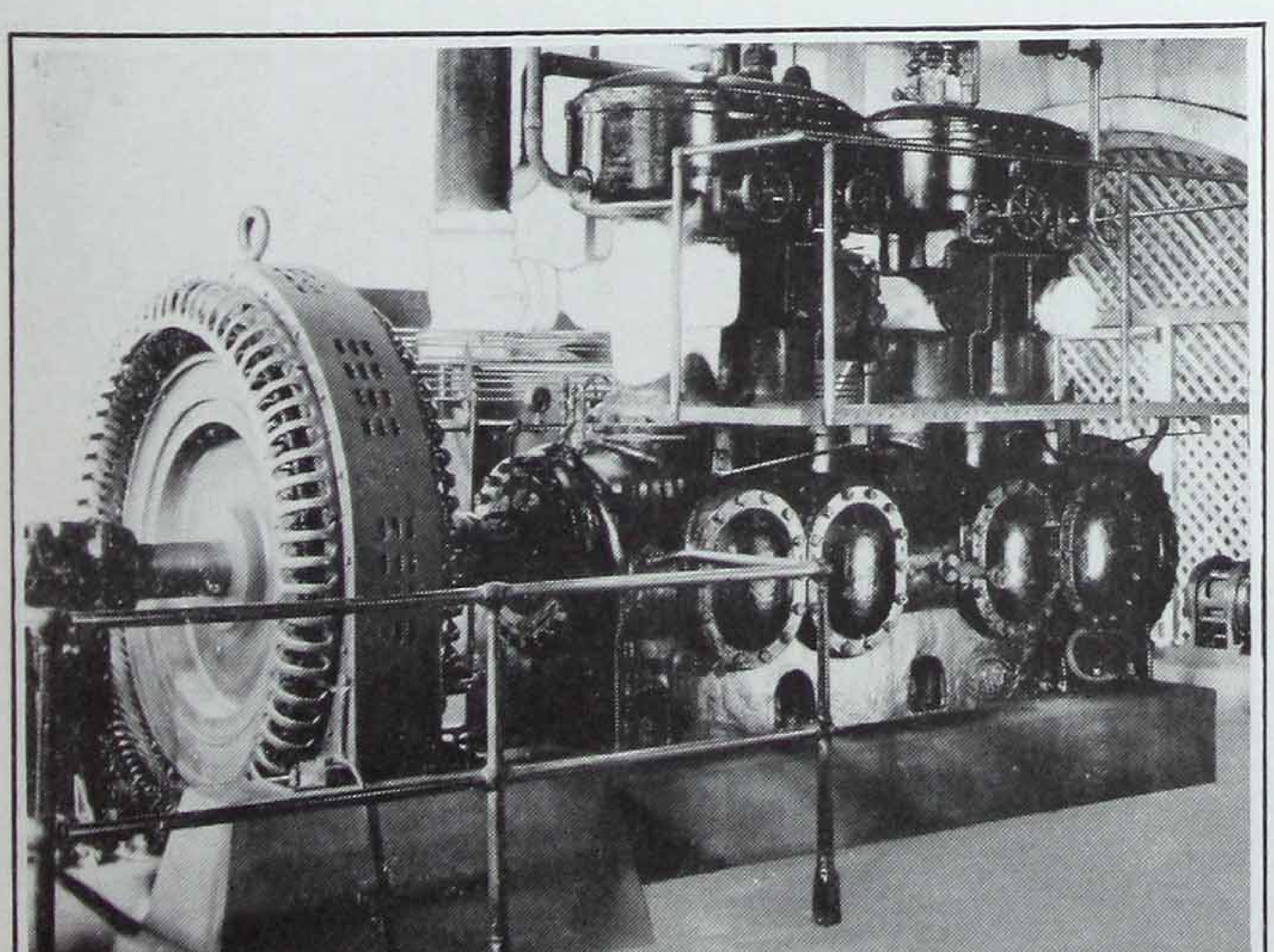


Fig. 90—12″ by 12″ 4-Cylinder Ammonia Compressor Making Over 125 Tons Ice Daily at Kingston, Jamaica.

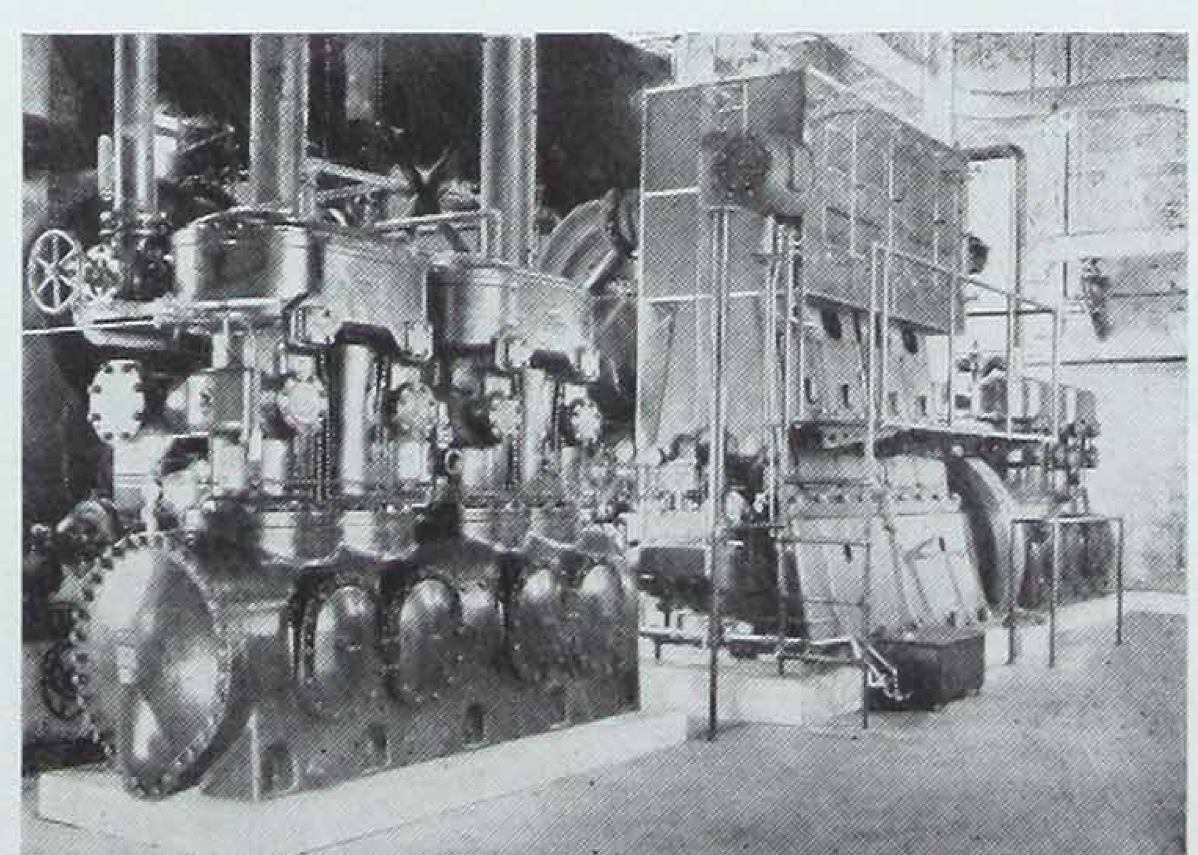


Fig. 93—Two of the Seven 4-Cylinder 14″ by 12″ Ammonia Compressors Used for Air Conditioning a Great Midwestern War Plant.

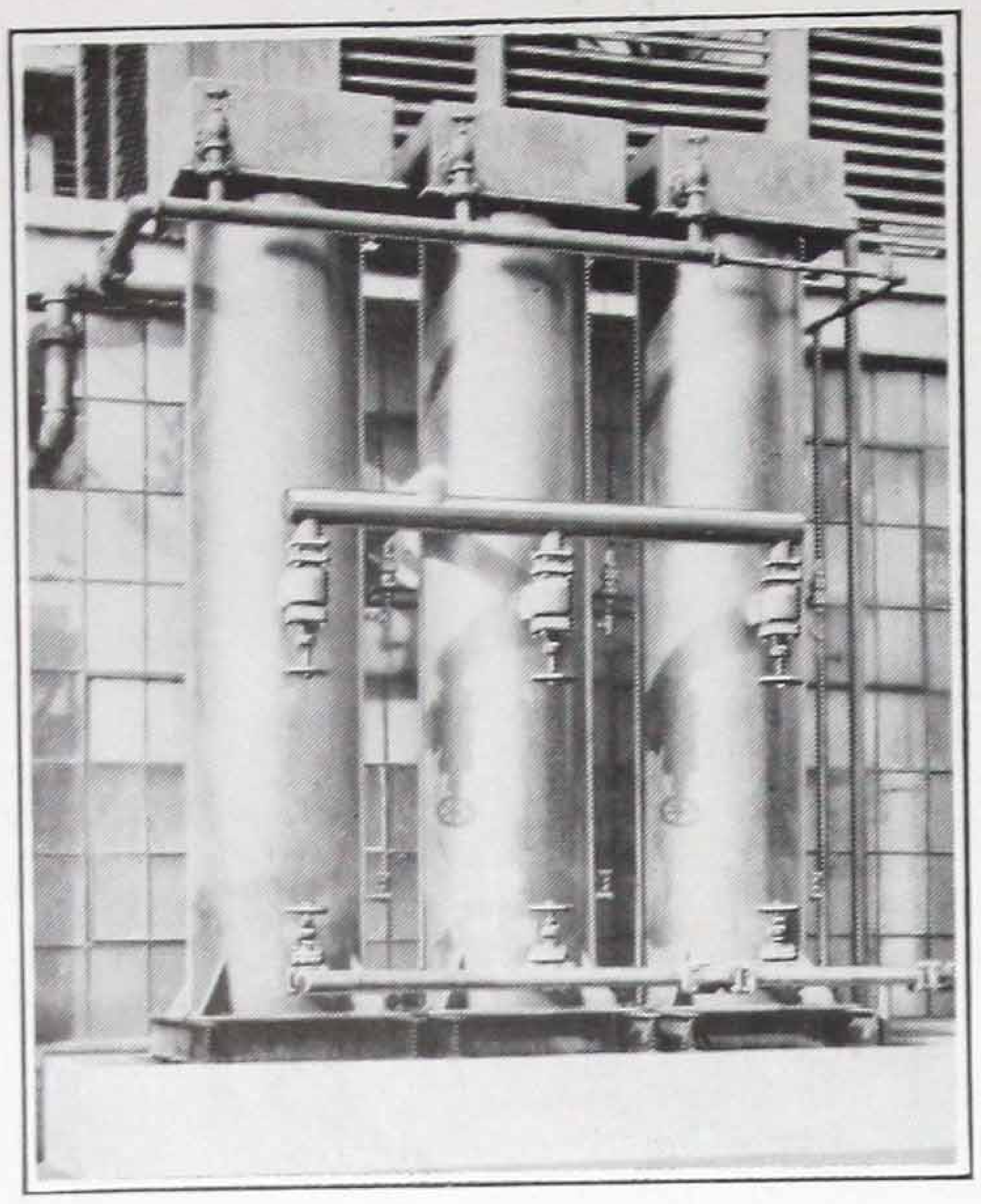


Fig. 94—Three Type VS Vertical Shell-and-Tube Condensers at the Bay State Fishing Company, East Boston, Mass.

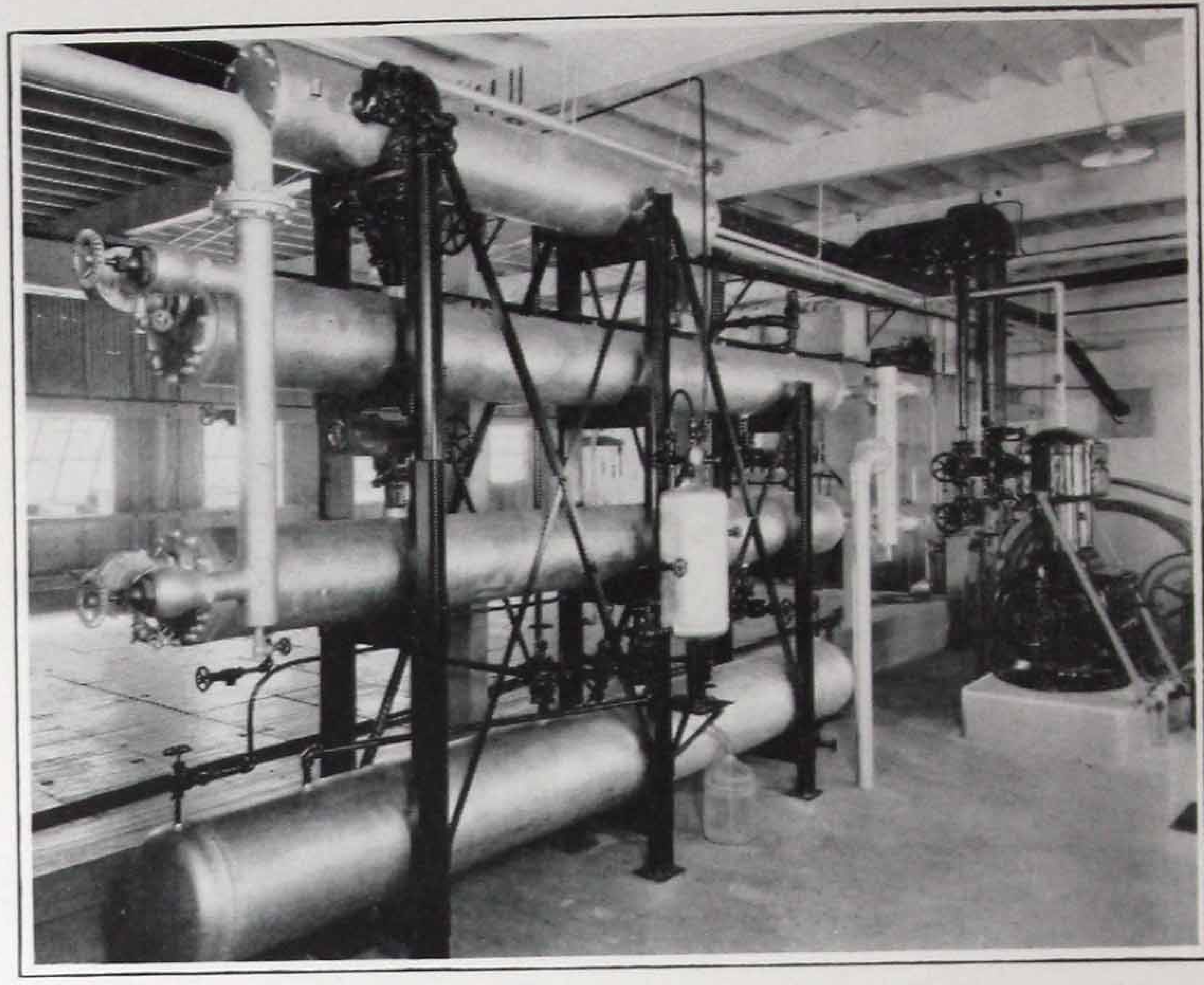


Fig. 96—Separator-Heater Mounted above two Type MS Multipass Shell-and-Tube Condensers at the 20-22 Ton One-Man Plant of the Pure Ice Company, Culver City, Calif. Note Ammonia Receiver Below.

Condensers

Double-pipe and atmospheric condensers can still be furnished, but have been largely superseded by the newer shell and evaporative types.

Vertical shell-and-tube condensers can be installed indoors or out; they use small floor space, have short pipe connections, and low pumping head for the water; simple and efficient, they are very easily cleaned, and weigh comparatively little for a given capacity. The water flows down the tubes with a whirling motion. The shells are regularly made with tubes 14 ft. long, and with heads of 1-in. steel plate. Type VS condensers are described in Bulletin 228.

Multipass (Type MS) condensers have one or more shells, each with a diameter of from 8 to 50 inches. The 1¼″ or 2″ tubes are arranged in groups, the water being directed back and forth through each group by divisions in the water heads. Bulletin 232.

Evaporative condensers have a rain of water circulated over the pipes by a pump and nozzles; cooling is effected by a stream of air which evaporates part of the water. This type condenser requires only about 5 per cent of the water used in other types, where no spray pond or cooling tower is available. Large evaporative condensers are built up on the job, other sizes being shipped assembled, complete with framing and sheathing. Bulletin 234.

Frick condensers, as well as oil separators and receivers, are each fitted with the necessary gas, liquid, purge, drain, and safety relief valves, liquid gauge glass, flanges for the water lines, and suitable stands or supports. The headers are ordered as separate items, and are of welded construction.

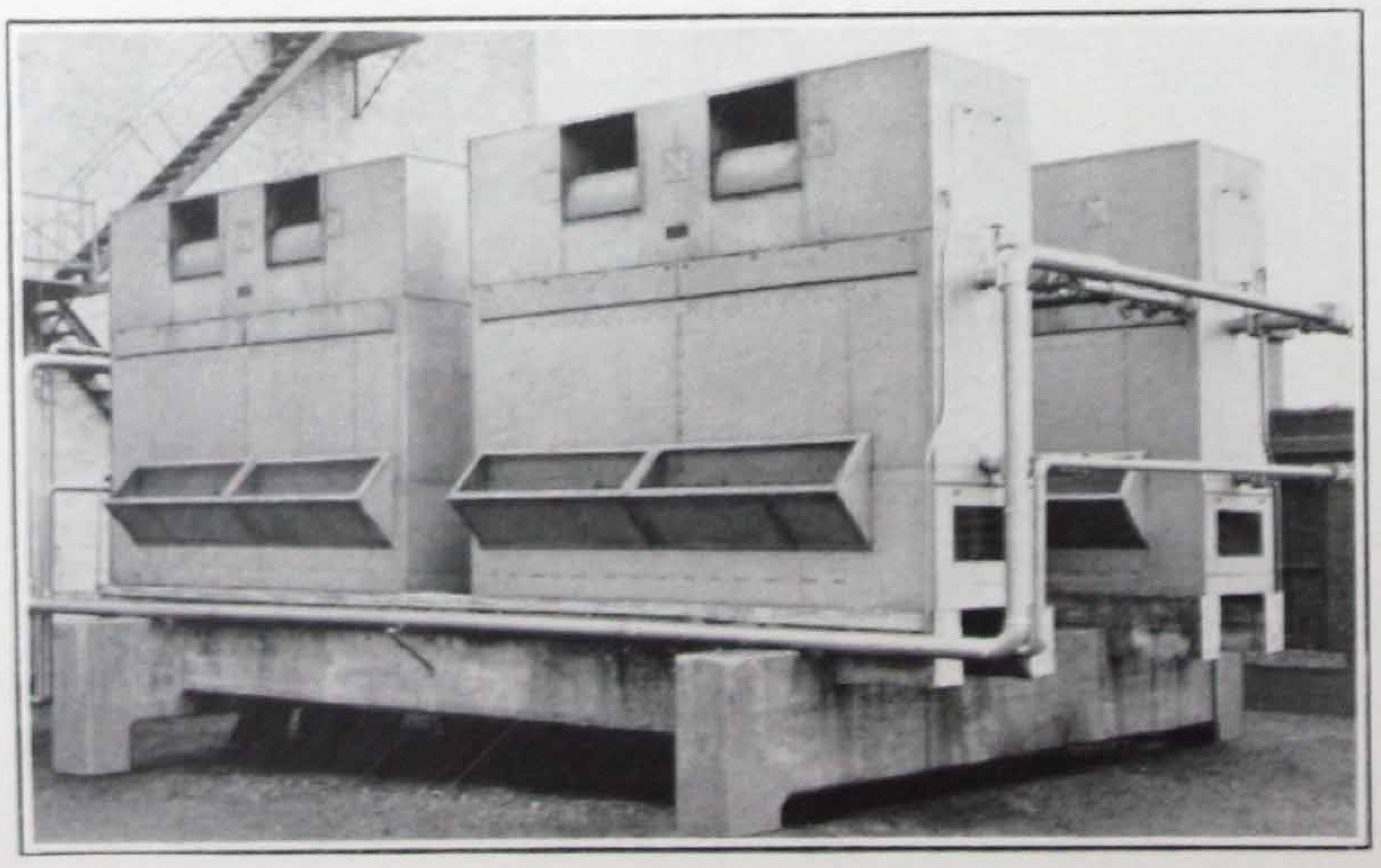


Fig. 95— Four Evaporative Condensers, each Shipped Complete with Housing, at the General Ice Cream Company, Buffalo, N. Y.

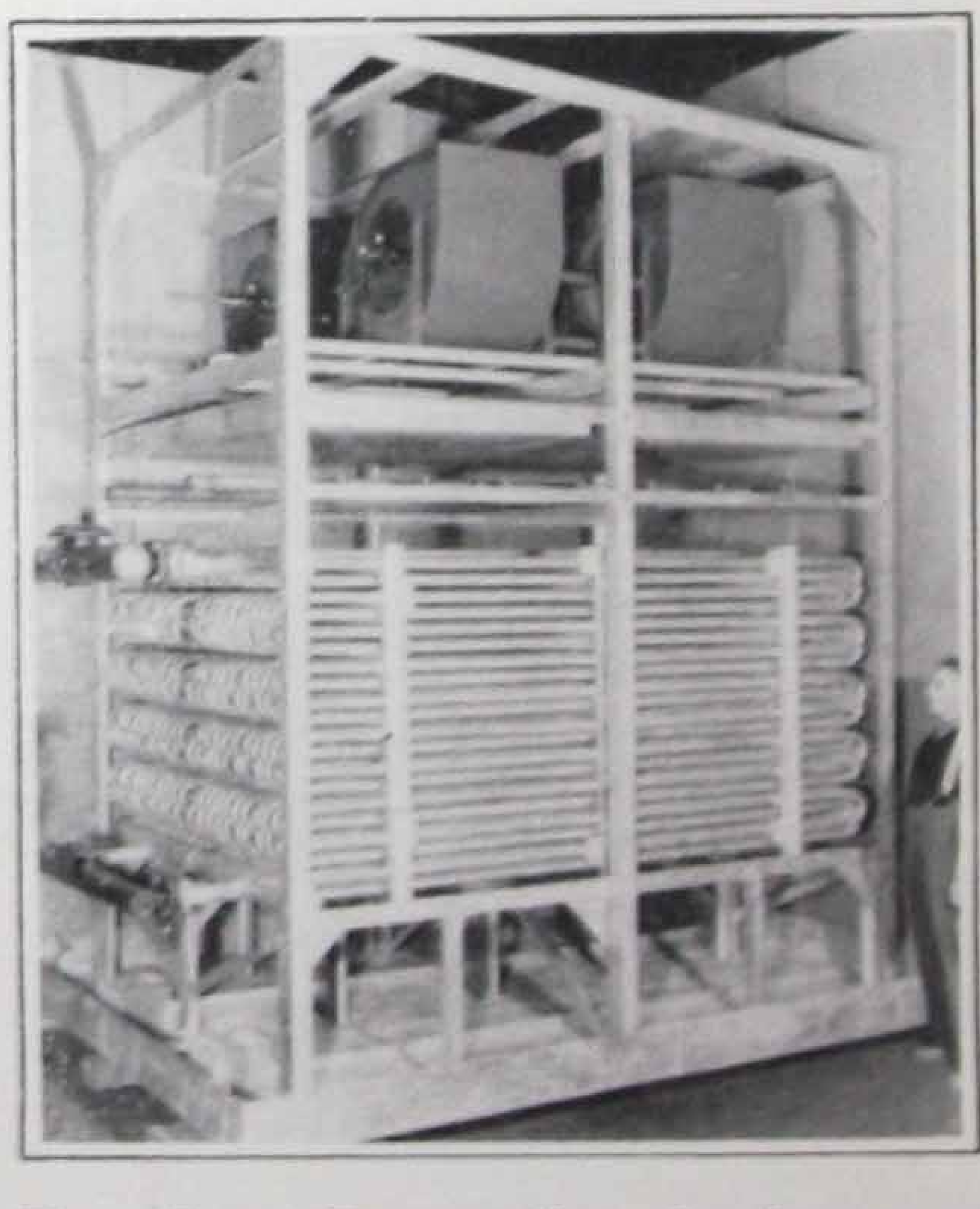


Fig. 97 — Evaporative Condenser of Large Size with Special Steel Framing, Assembled in the Frick Shops Prior to Dismantling and Shipment.

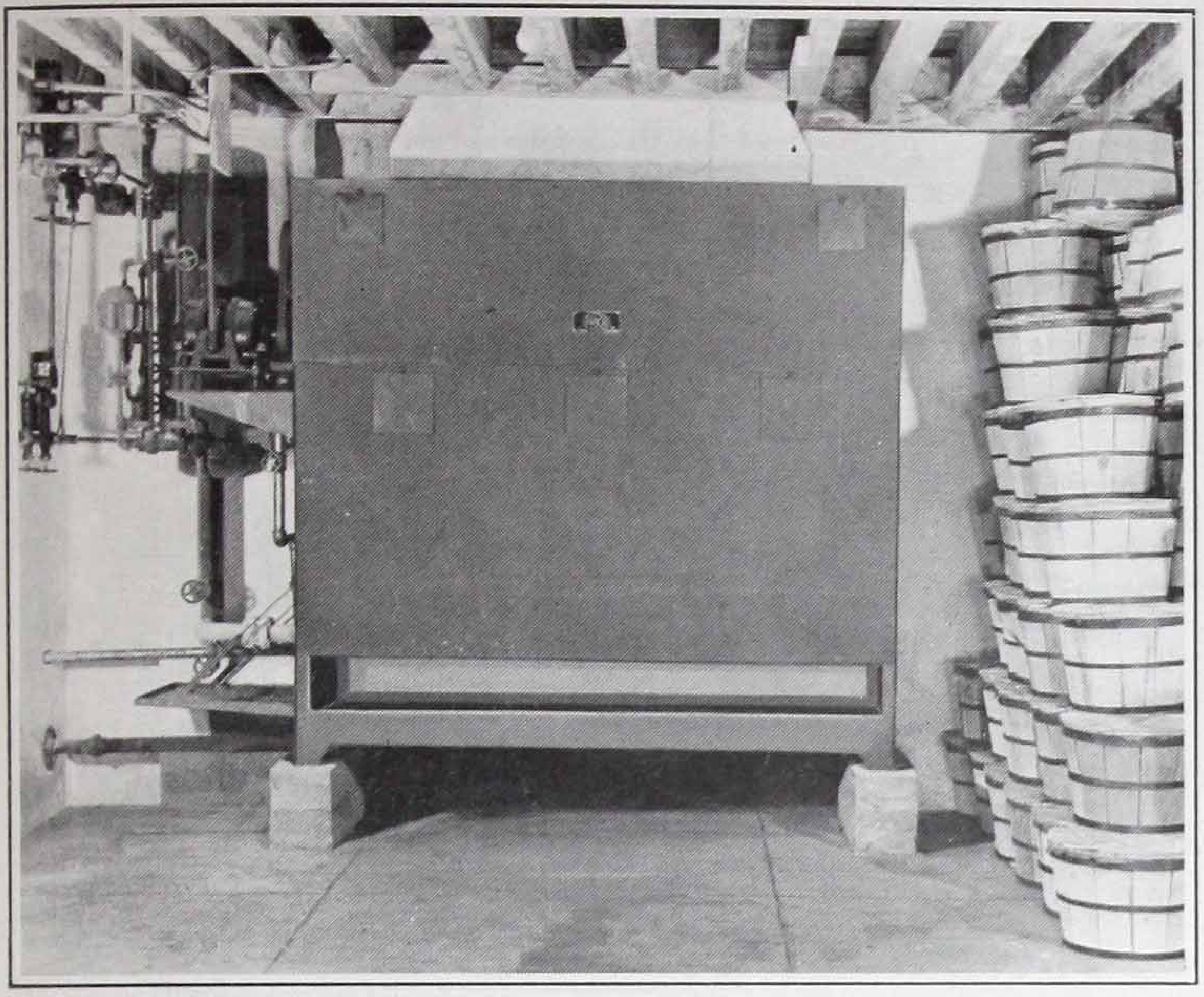


Fig. 98—Air Cooling Unit, with Accumulator and Float Valve Control, Cooling a Fruit Storage at Greensboro, N. C. See Bulletin 185

Coolers and Coils

Are furnished in the types illustrated, along with numerous others. Shell-and-tube coolers have the same design as multipass shell condensers, and are made in sizes from 8 to 50 in. in diameter. Submerged coolers and special coils are both used for cooling liquids. Air cooling units can be applied to freezer storage as well as work at higher temperatures. The patented Instant or Zig-Zag cooler is widely used for supplying cold water in dairy, bottling and ice plants.

Frick cooling coils are fabricated in our own shop to meet any needed design. The type VW coil, either single or nested in intertwining groups, has many advantages. We make finned coils, spiral and hairpin coils, flanged, continuous welded, black or galvanized coils, and special arrangements such as Vertiflow units, shown on Page 6.

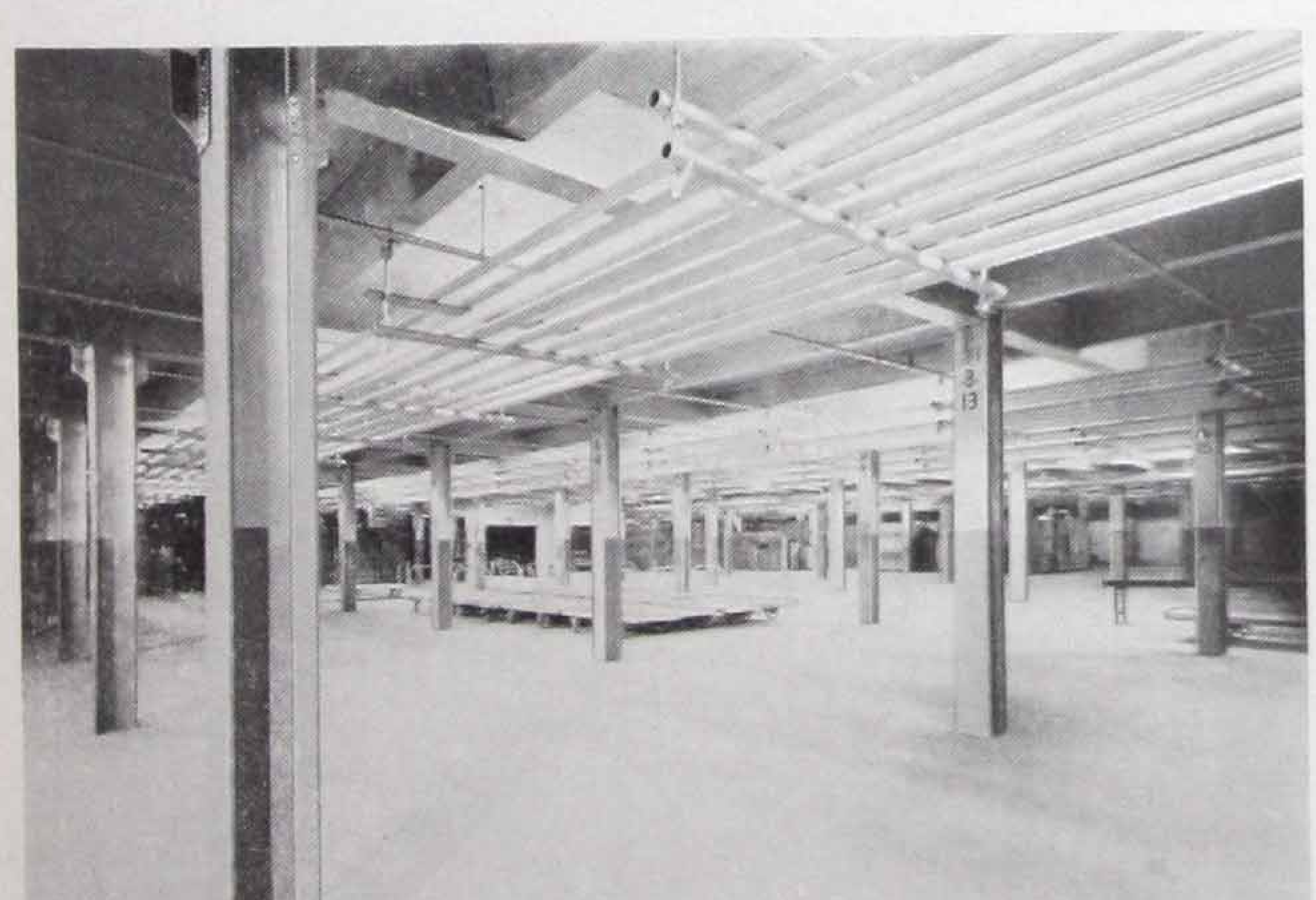


Fig. 99—Ceiling Coils Maintaining Minus 10 Deg. F. in One of Two Storages, Each Holding 21 Million Pounds of Frozen Food, at Seabrook Farms, Bridgeton, N. J.

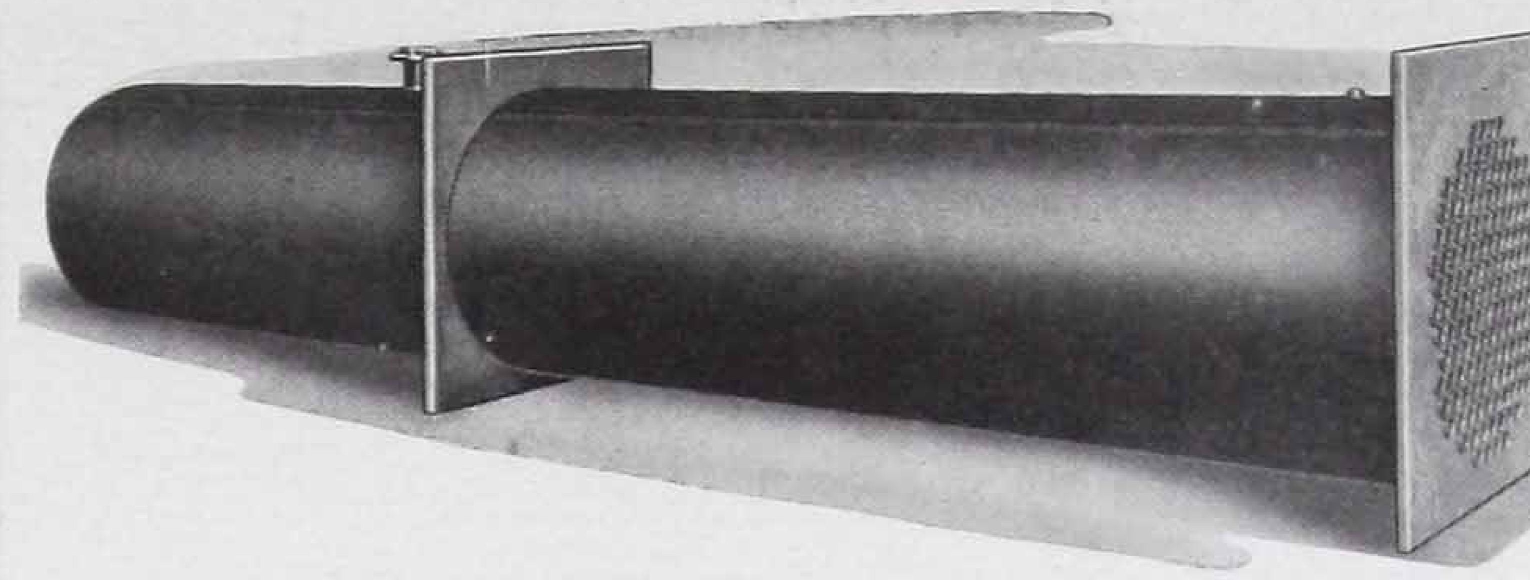


Fig. 100—Submerged-Type Shell-and-Tube Brine Cooler Arranged with Baffle Plates, as used in Ice-Making Tanks.

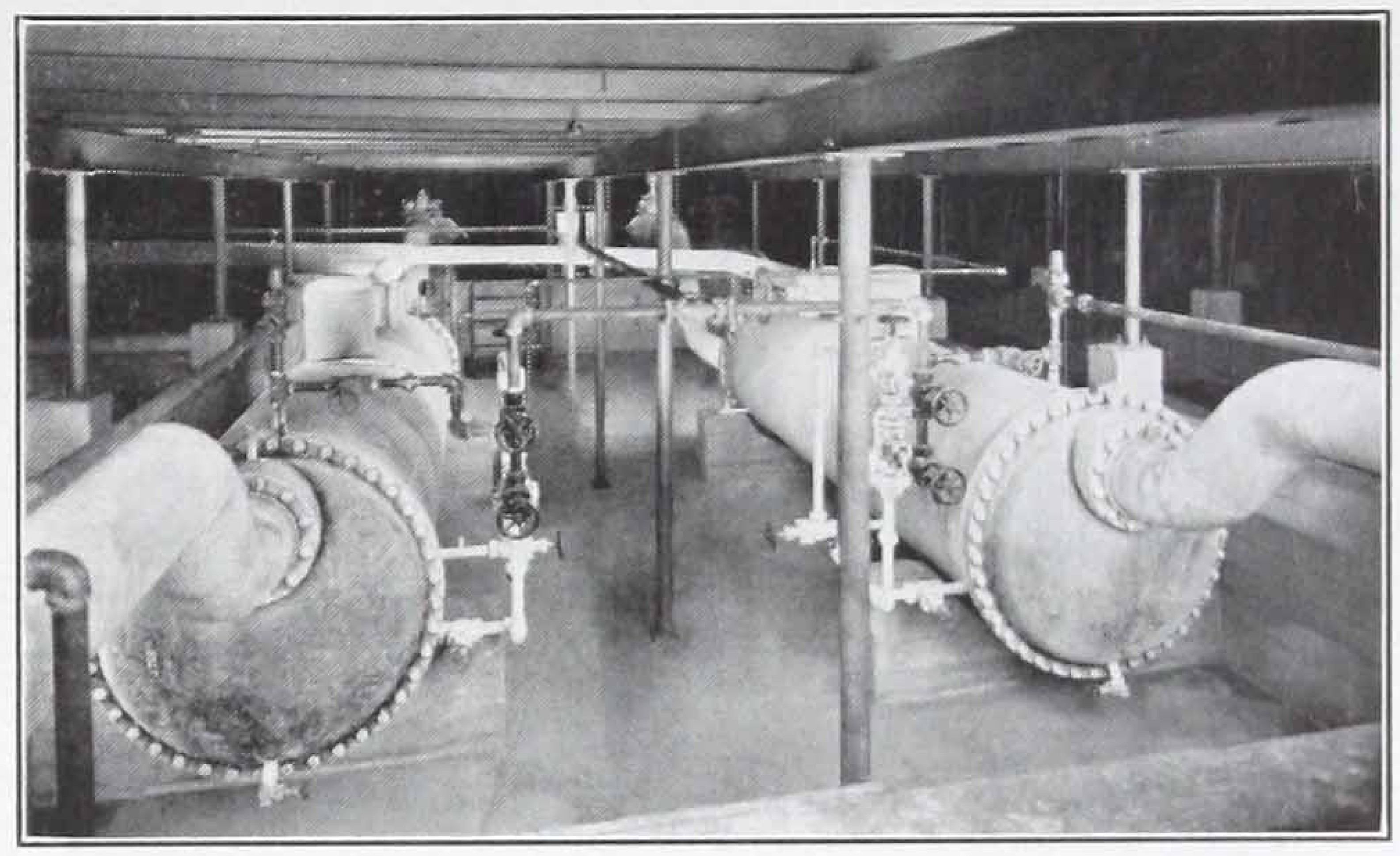


Fig. 101—Two Shell-and-Tube Coolers Chilling Brine for an Ice Skating Rink.

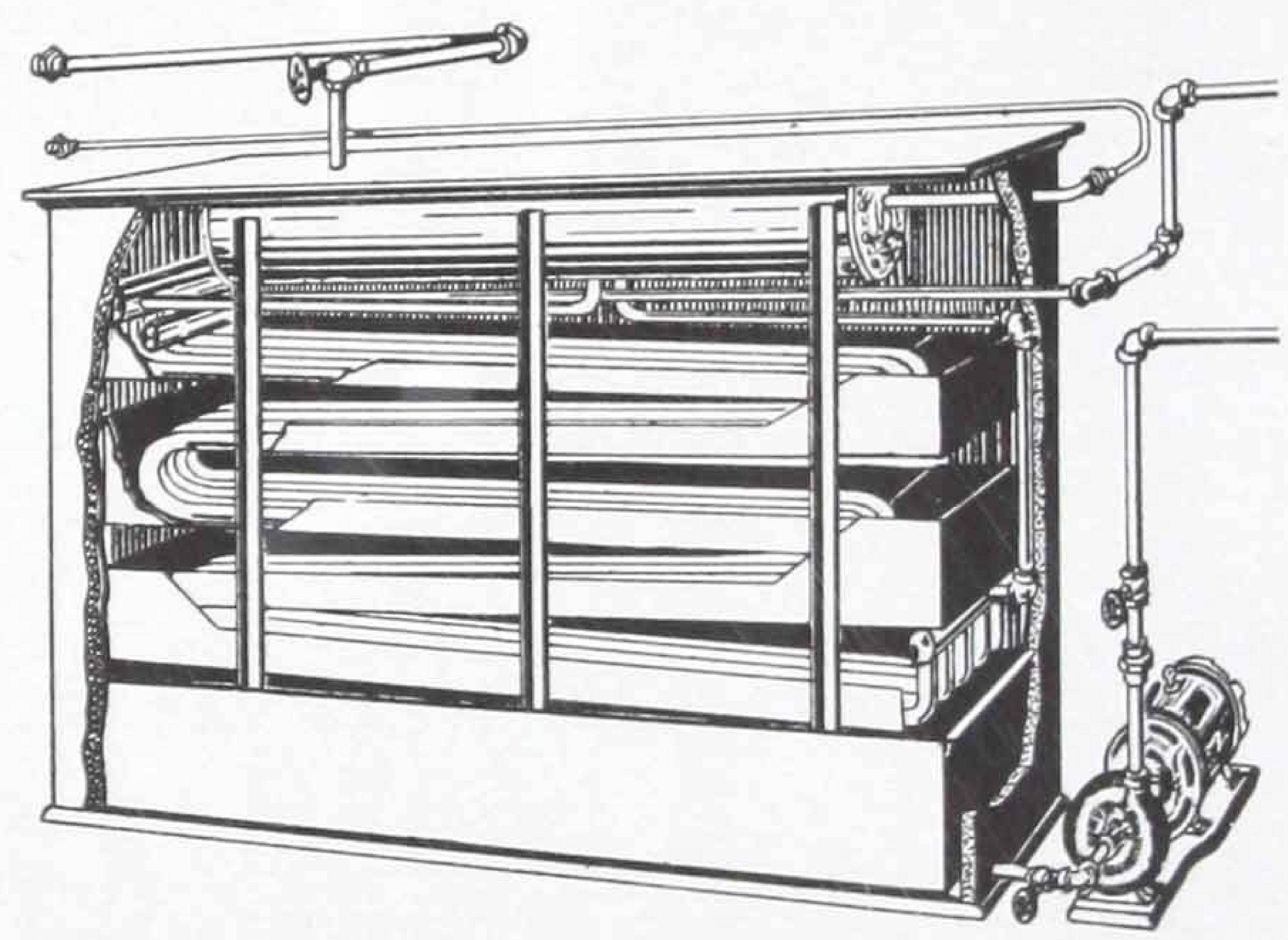


Fig. 102—Patented Instant Water Cooler, with Float Accumulator at Top. See Bulletin 153.

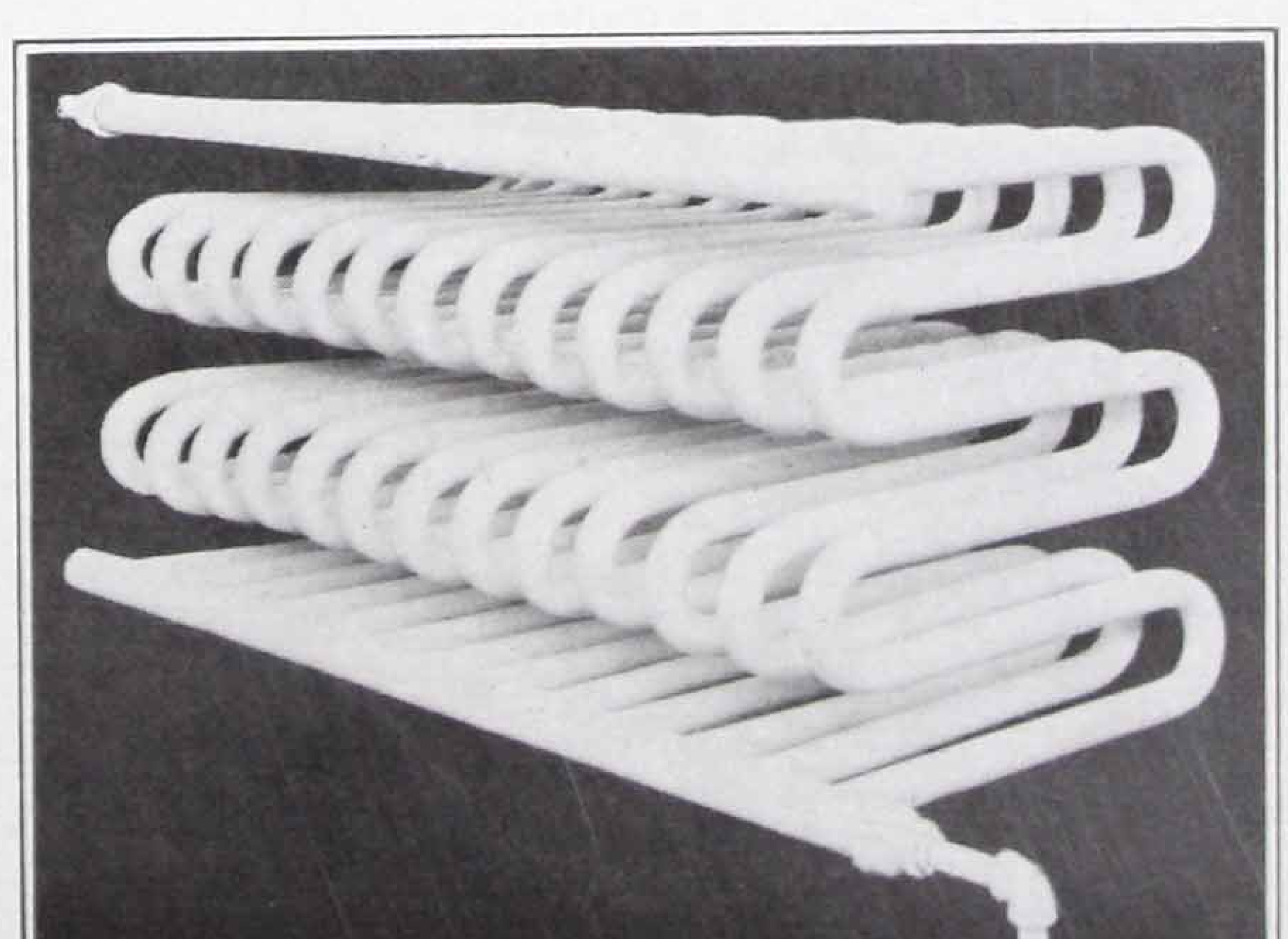


Fig. 103—Type VW Cooling Coils Find Many Applications. Built in Two Standard Sizes, Stocked Ready for Use. See Bulletin 156.

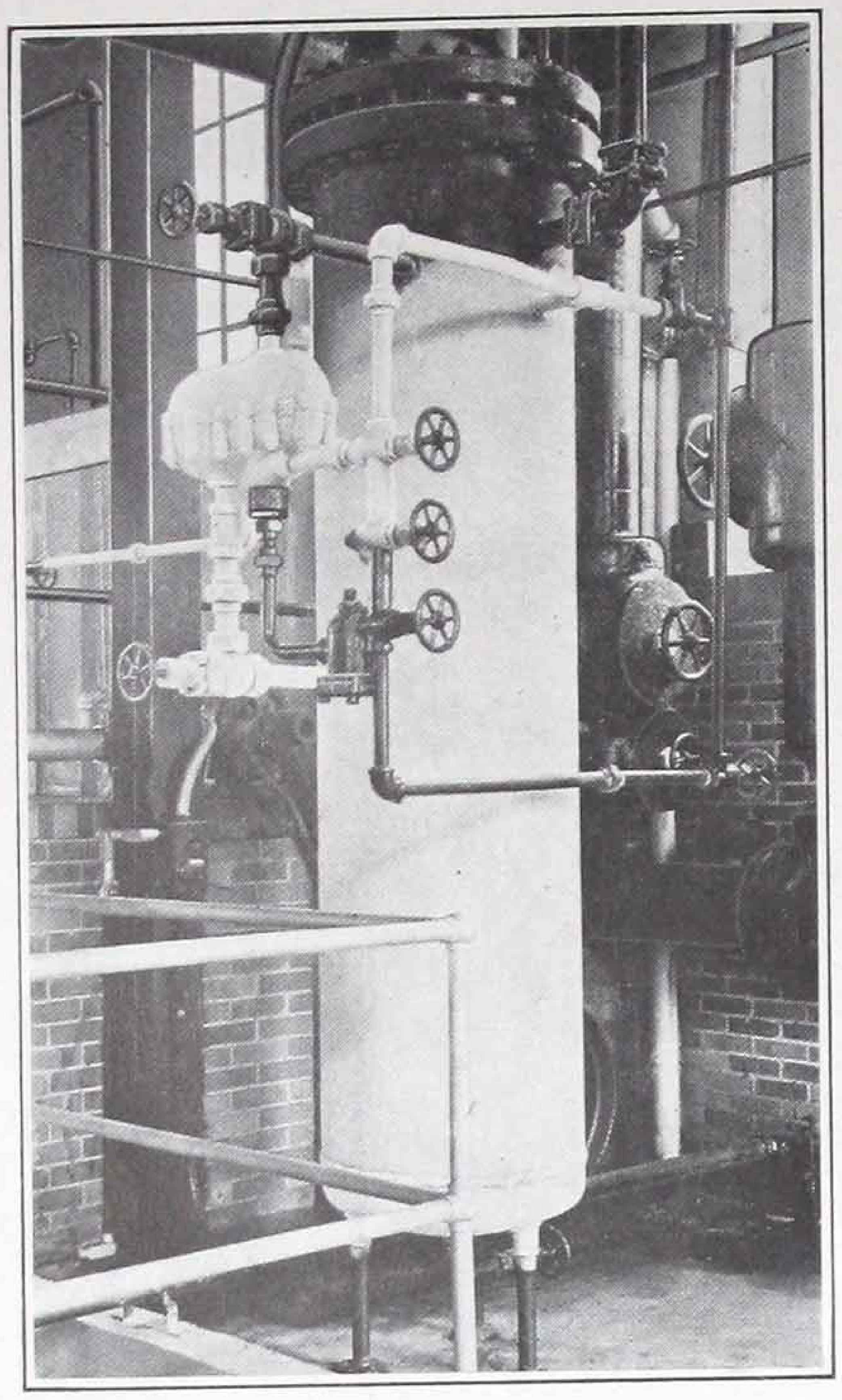


Fig. 104—Float Valve Control Applied to a Liquid and Gas Precooler in a Frick Ammonia Booster System.

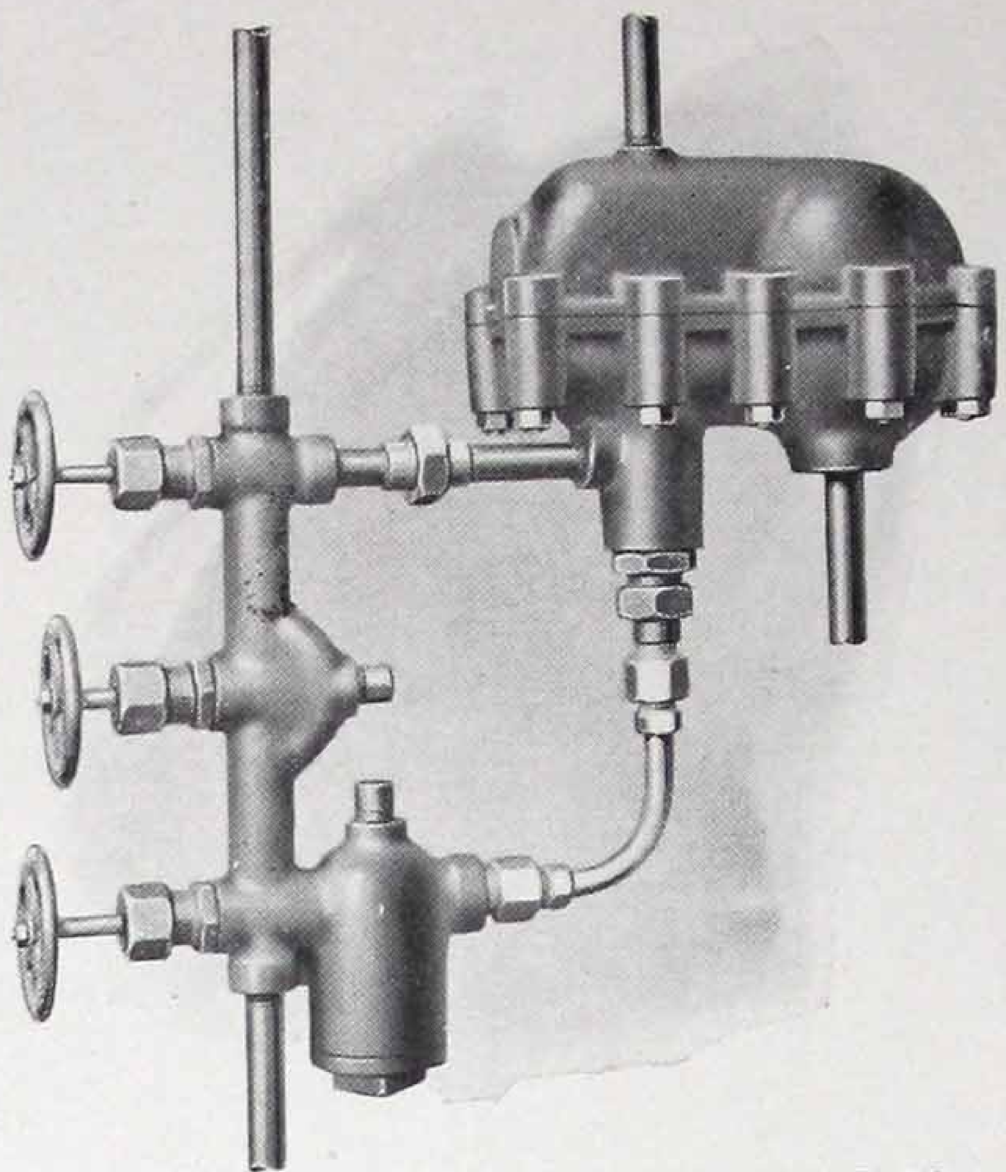


Fig. 107—One-piece Bypass and No. 1 Float Connected for Liquid Level Control. See Bulletin 201.

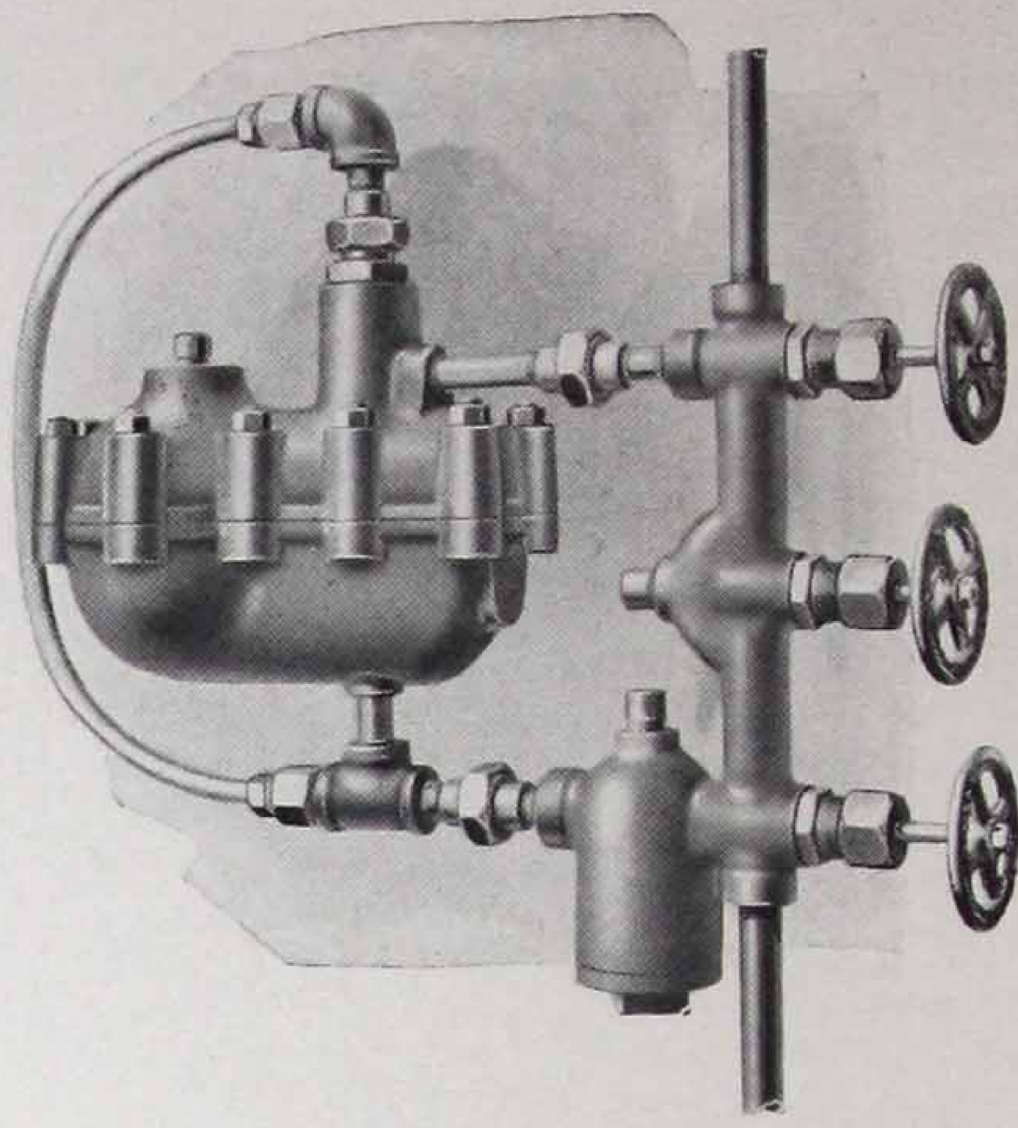


Fig. 108—No. 1 Float Valve with Bypass Manifold, Arranged for Float Expansion Control.

Control Equipment

Automatic controls are now applied to refrigerating installations of even the largest size.

Float valve controls keep the coils or coolers properly flooded at all times and automatically balance the load; the highest practicable suction pressure is maintained. These controls can either be arranged to maintain a certain liquid level or to regulate the expansion so that only enough liquid refrigerant remains in the receiver to keep a liquid seal.

Frick electric control valves are furnished either separately or as part of a bypass, complete with liquid strainer. The valves remain either tightly closed or are opened wide by an electric magnet connected to a thermostat or relay. The design eliminates stuffing boxes. Electric control valves are used as unloaders on compressors, in addition to their other numerous applications.

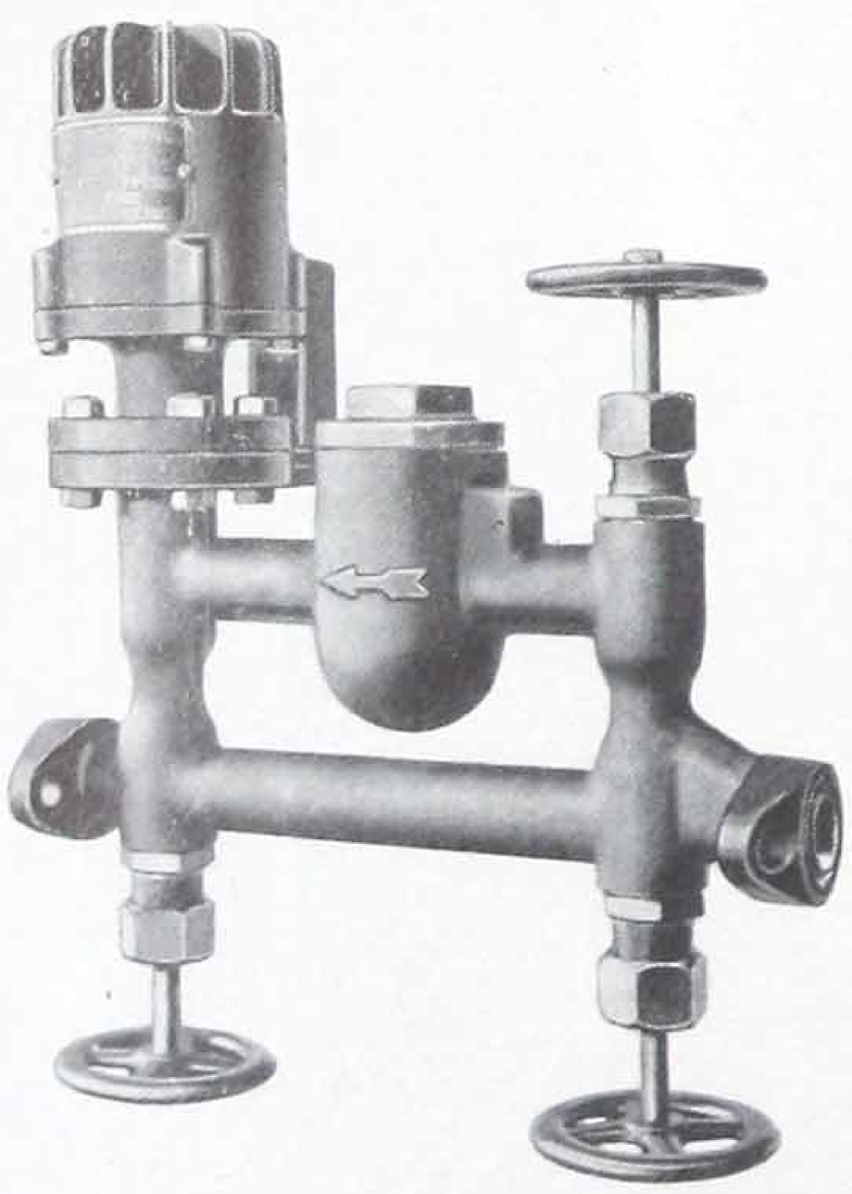


Fig. 105—Angle-Type Electric Control Valve, Complete with Manifold Bypass and Strainer. See Bulletin 203.

Frick purgers soon pay for themselves by eliminating air and other non-condensable gases from the system, without appreciable loss of refrigerant; the lower head pressure results in important power savings. These purgers operate under full condenser pressure, and are usually hand-controlled. They are simple, reliable, and highly effective.

Automatic controls, group lift equipment, and suitable conveyors now make it possible for one man, working one daylight shift of eight or ten hours, to freeze, harvest, score, and run into the storage, from 50 to 60 tons of ice daily.

We are glad to supply such other control equipment as thermostats, pressurestats, automatic expansion valves, electric cutouts, alarm bells, pressure or water regulators, thermometers, safety devices, etc., etc.

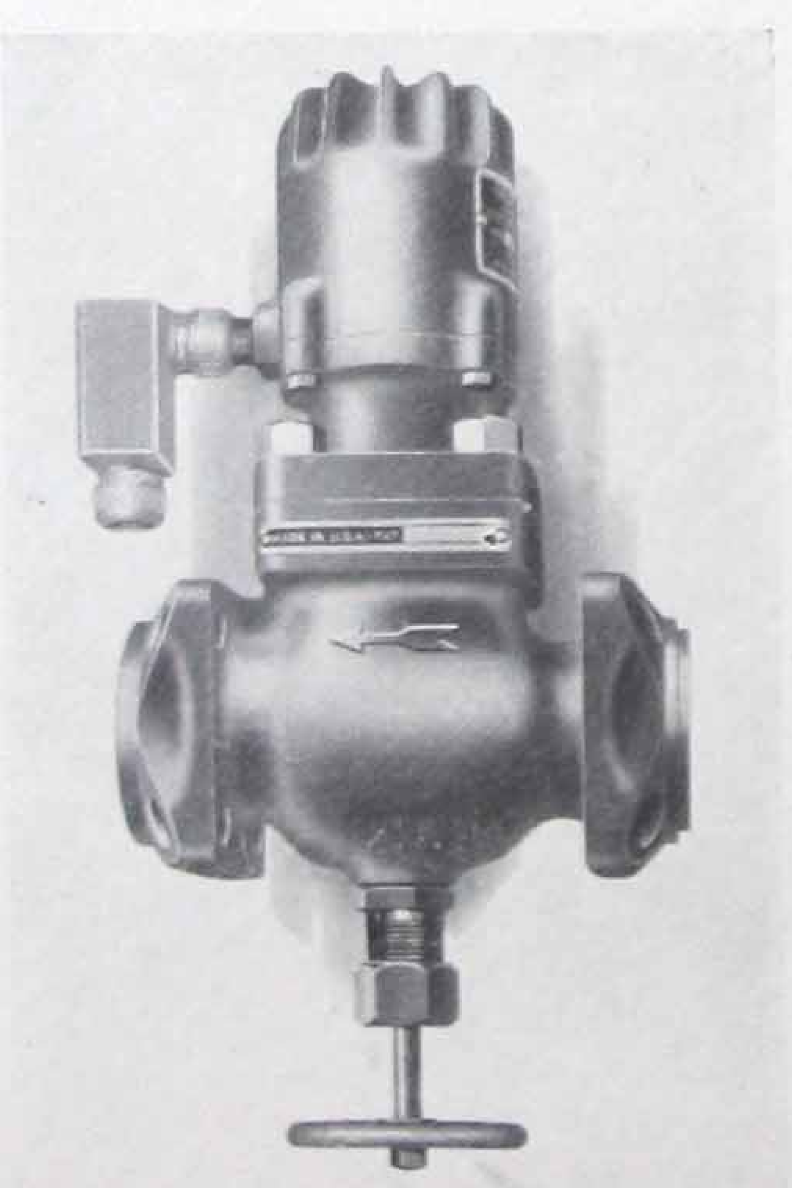


Fig. 106 — Electric Control Valve of Globe Type, with Built-in Bypass.

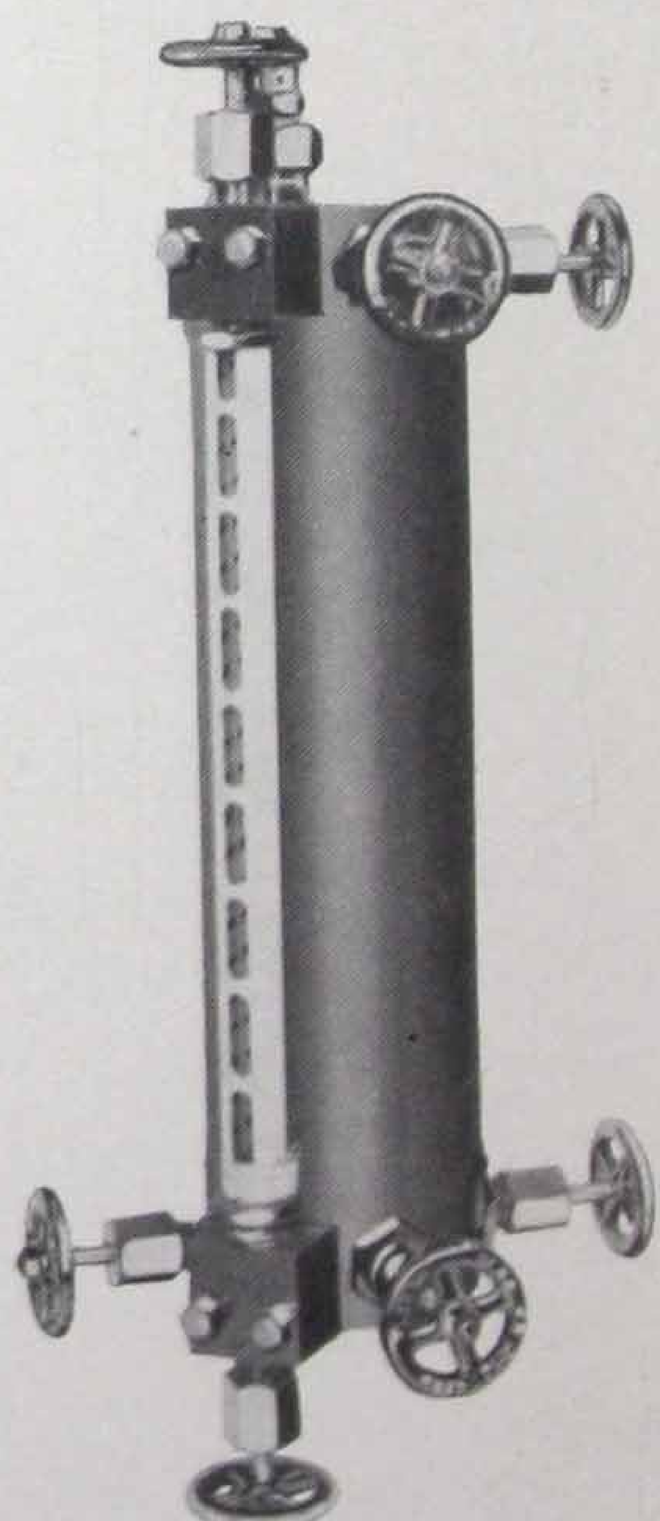


Fig. 109—Frick Little-Giant Purgers are Made in Two Sizes. See Bulletin 200, also 337.

Fig. 110—Frick Valves and Fittings are Furnished in Sizes from ¼-in. to 14 in.

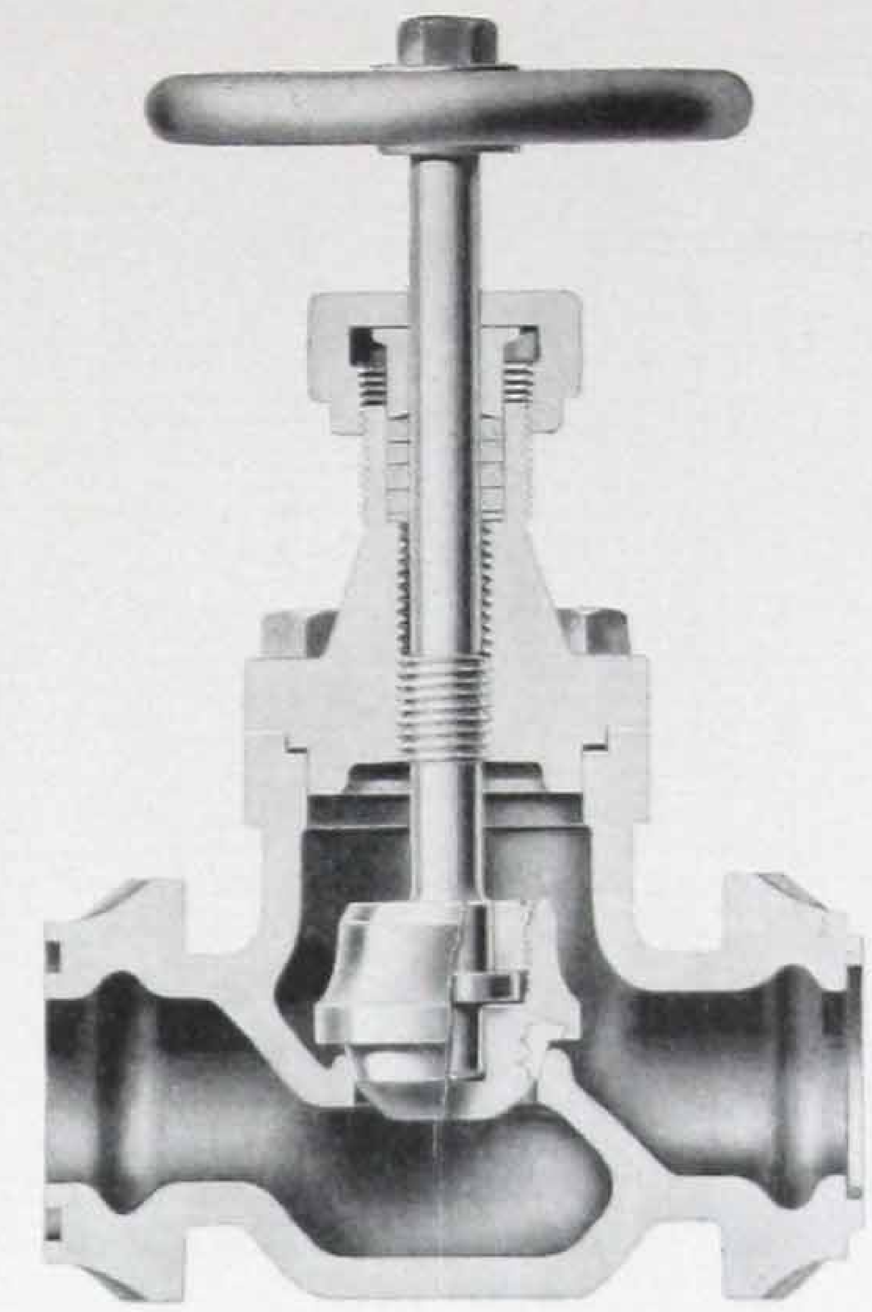


Fig. 115—Section Through Frick Valve, Showing High-angle Seat

Fig. 111—Square-flanged Angle Valve

Valves and Fittings

Among the outstanding features of Frick patented valves, the following are of special interest:

The usual collar, stuffing-box, and bonnet are combined into one piece. The long valve stem, of cold-rolled steel, is made oversize for strength.

A firm alloy metal is rolled into the groove on the steel disc, which seats at such a sharp angle that a tight joint is insured, and one which adjusts itself to wear. The valves are carefully tested and are shipped with stems packed, ready for service. When fully opened, the tapered shoulder on the top of the disc seats against a groove on the bonnet, permitting the stem to be repacked without pumping out the line.

Valves in sizes below 1 inch have hard seats: 1-in valves are made with either hard or alloy seats, as ordered. All other valves are furnished with alloy seats.

Carbon-dioxide valves have similar advantages, and are specially designed for the high pressures involved.

In addition to the regular globe, angle and tee valves, we manufacture check valves, gauge valves, safety valves, and a complete line of flanged and screwed fittings, including elbows, tees, crosses, flanges, couplings, unions, strainers, gaskets, return bends, condenser parts, bushings, plugs, rings, etc. Welding-neck flanges also supplied. Valves and fittings are furnished in pipe sizes from $1/4$-in. to 14-in. inclusive.

Ask for a copy of Valves and Fittings Catalog K. Also for Bulletin 192, giving the higher working pressures under which these valves and fittings can be used for various purposes. In ordering, state whether valves are for ammonia or Freon service.

Fig. 116—Screwed Tee Valve.

Fig. 112—Flanged Tees, ¼″ to 12″

Fig. 117—Safety Relief Valves, Sizes up to 2″

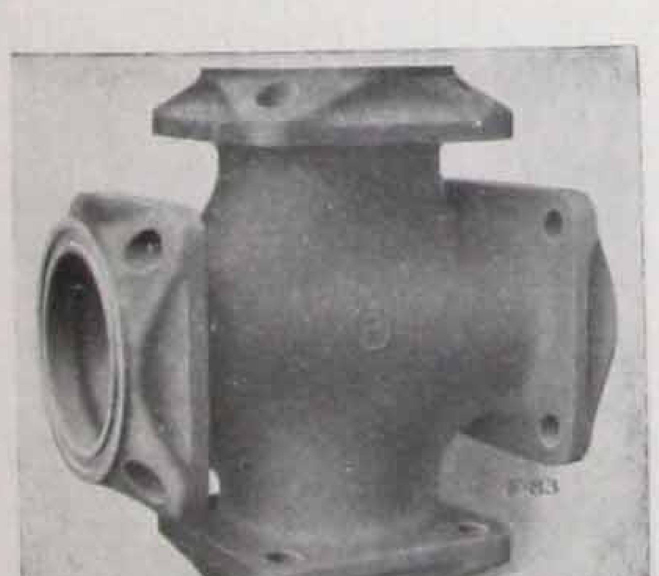


Fig. 113—Flanged Crosses, ¼″ to 8″

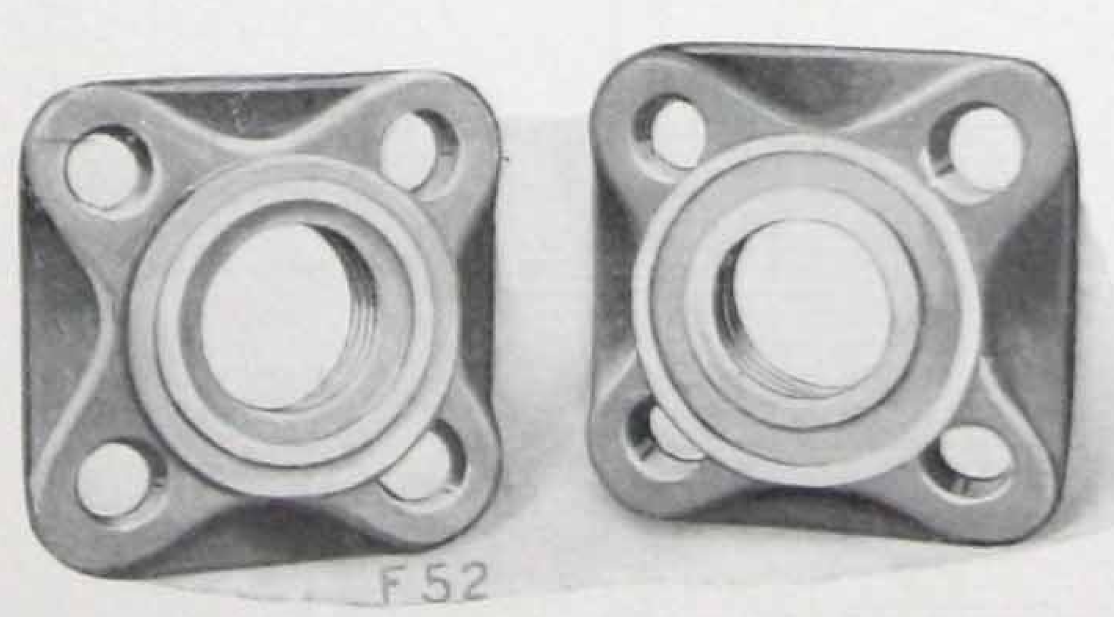


Fig. 114—Oval, Square and Round Flanges, ¼″ to 14″

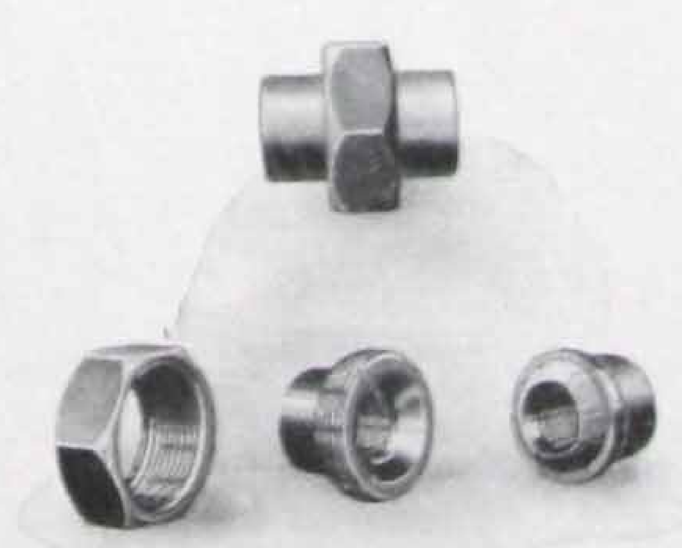


Fig. 118—Steel Ammonia Unions, ⅛″ to 1½″

Fig. 119—The Philcade and Philtower Buildings at Tulsa are Air Conditioned by the Frick Machines shown in Fig. 4

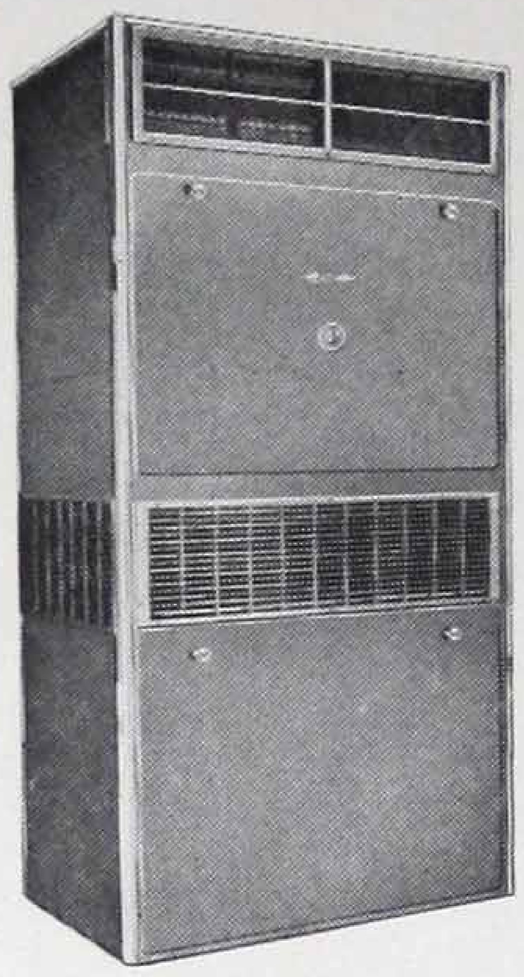


Fig. 120—Unit Air Conditioner

Fig. 124—This Coffee Shop as well as the Main Dining Room in the Alexander Young Hotel, Honolulu, uses Frick Freon-12 Refrigeration for complete Air Conditioning.

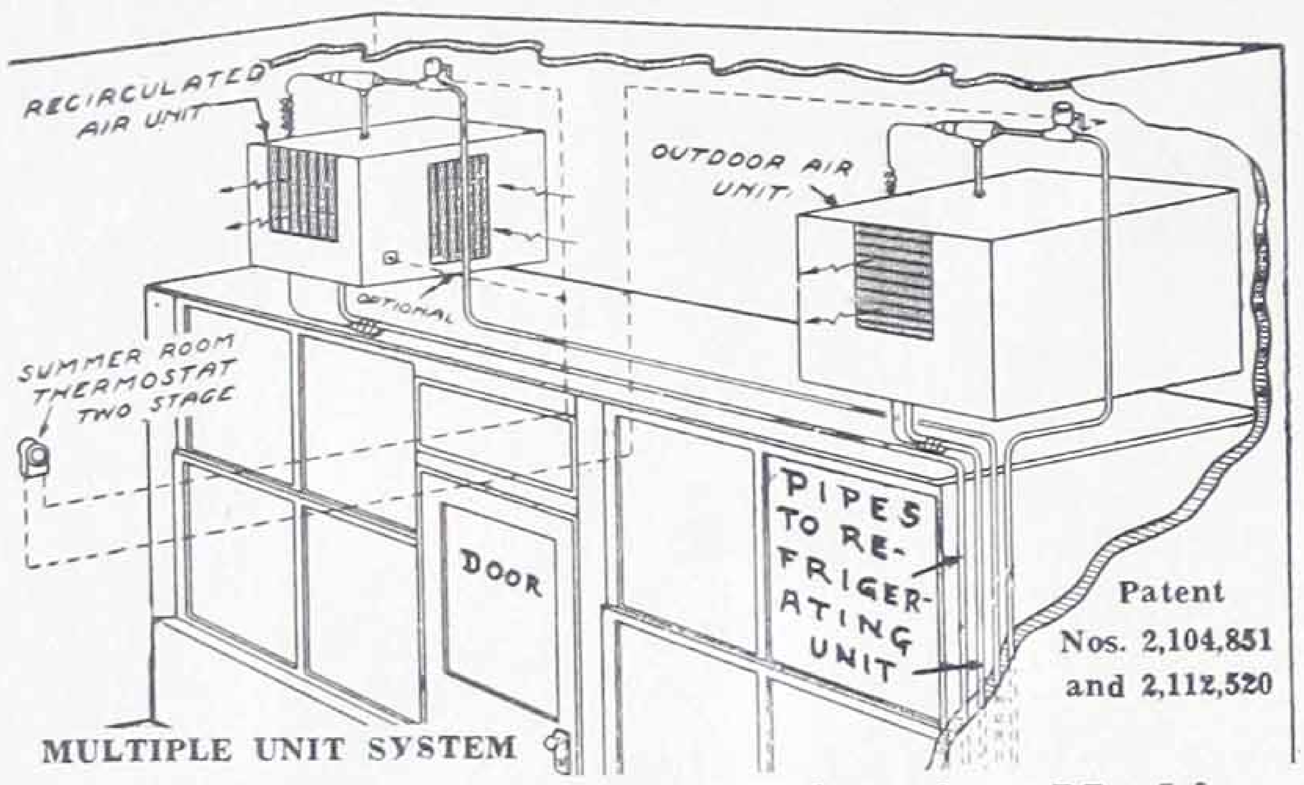


Fig. 121—Patented System Using One Machine and Two or More Unit Coolers.

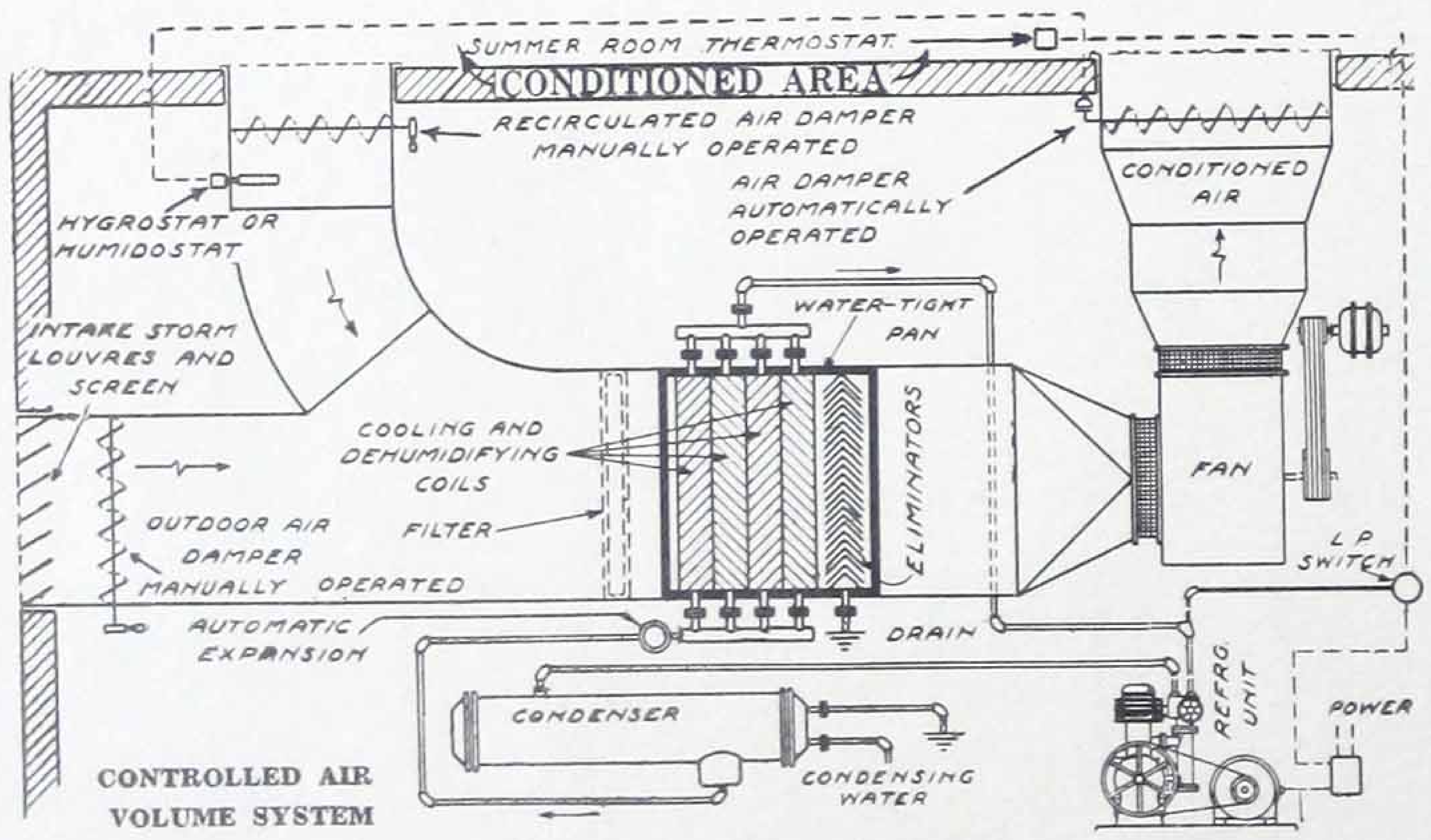


Fig. 122—This System is Excellent for Loads having Little Moisture

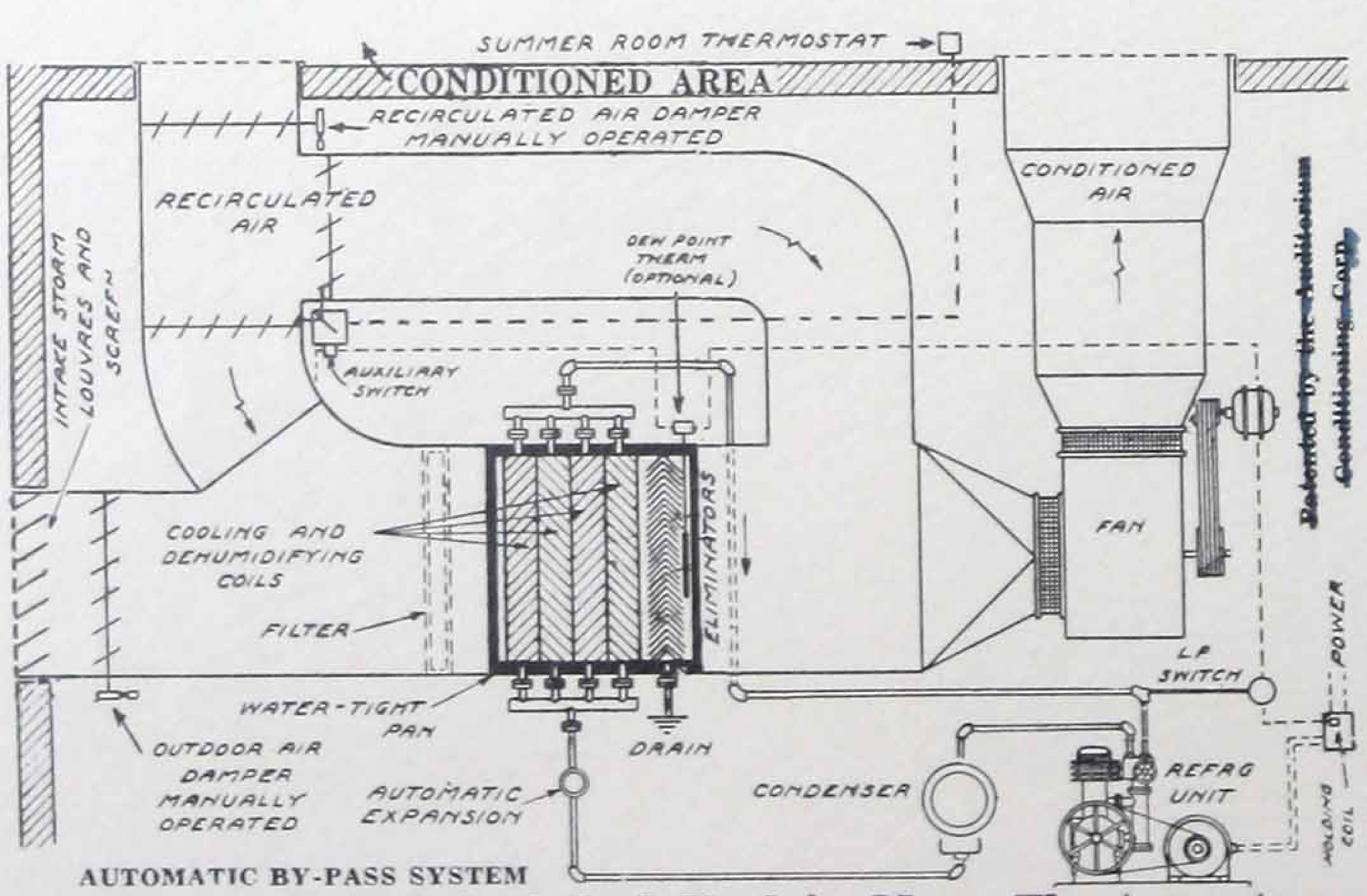


Fig. 123—Patented Method Used in Many Theatres, etc.

Air Conditioning Systems

First considered a luxury, air conditioning has proved very profitable to many businesses. Complete air conditioning is the simultaneous but independent control of the temperature, humidity, motion, and purity of the air in an enclosure. We offer five methods of handling the work: each gives more accurate control than the one preceding. All are described in Frick Bulletins 502 (hospitals), 503 (ammonia plants), 504 (typical installations), and 505 (details of systems.)

UNIT AIR CONDITIONERS

These are used most often in restaurants, offices, and small shops. They cool the air an average of 15 to 20 degrees, and condense out excessive moisture. Both fresh and re-circulated air pass through a filter and then over finned cooling coils. The blower discharges through adjustable grills into the room or ducts. By reducing the fan speed, the coils can be kept colder and the air made dryer. Fan operates continuously. Heat collected is carried away by water-cooled condenser. Two sizes, 3 and 5 hp.

MULTIPLE-UNIT SYSTEM

When load is not over 30 hp., two or three unit coolers can be connected to the same refrigerating machine, giving better humidity control. One unit handles only fresh air, the other recirculated air. Both fans run continuously, but a two-stage thermostat admits refrigerant through a magnetic valve into the fresh air unit before it is admitted to other unit or units. Compressor operates only when suction-line pressure rises; it works under a higher, more effective pressure as load increases. This patented system keeps relative humidity from rising when outdoor weather is mild.

Army Air Corps Photo.

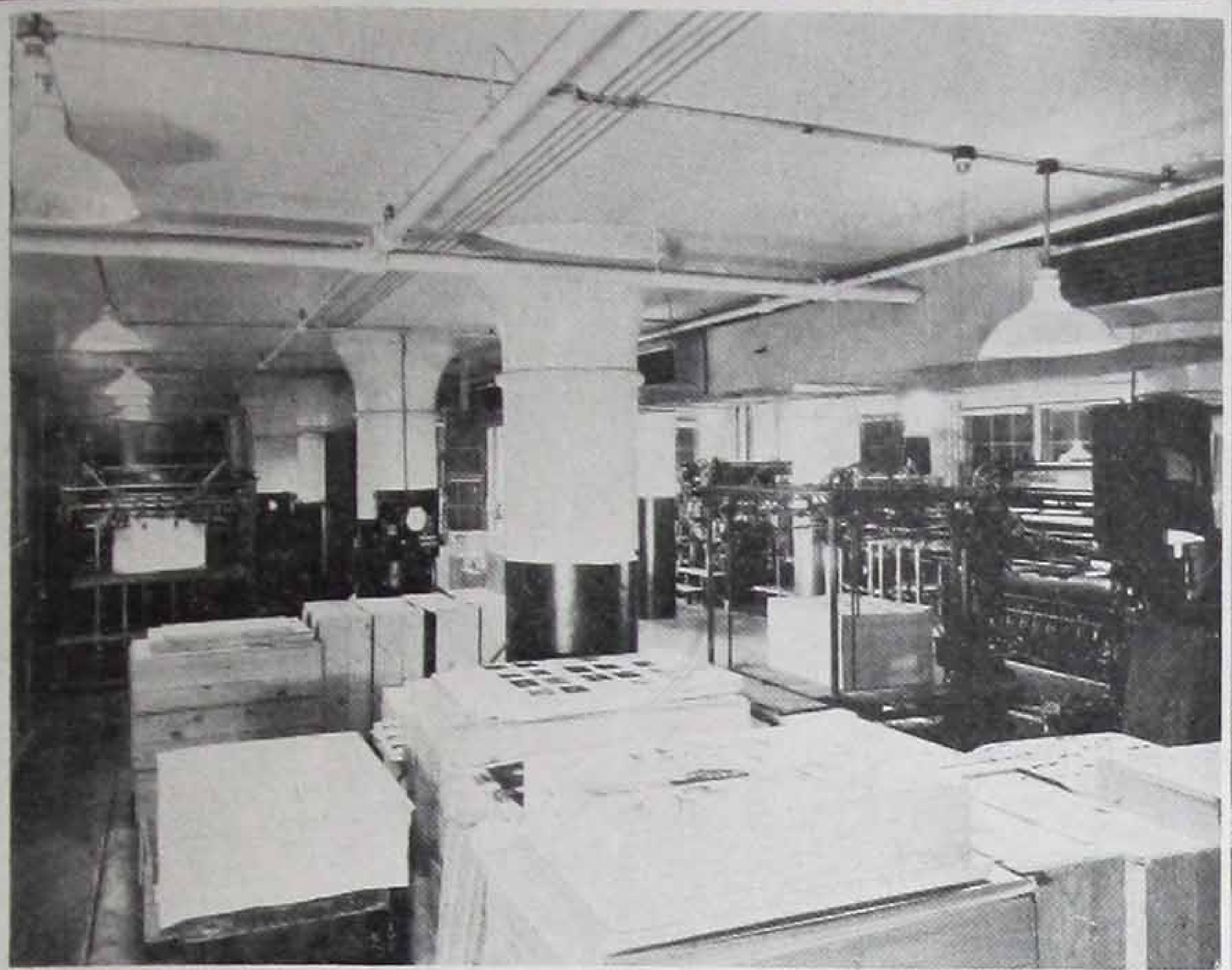


Fig. 125—Industrial Plants of Many Kinds are Installing Air Conditioning as a Profitable Aid in Process Work as Well as for Human Comfort.

Fig. 126—Restaurants, Tap Rooms, Hotels, Clubs, etc., all Find Frick Air Conditioning Very Popular.

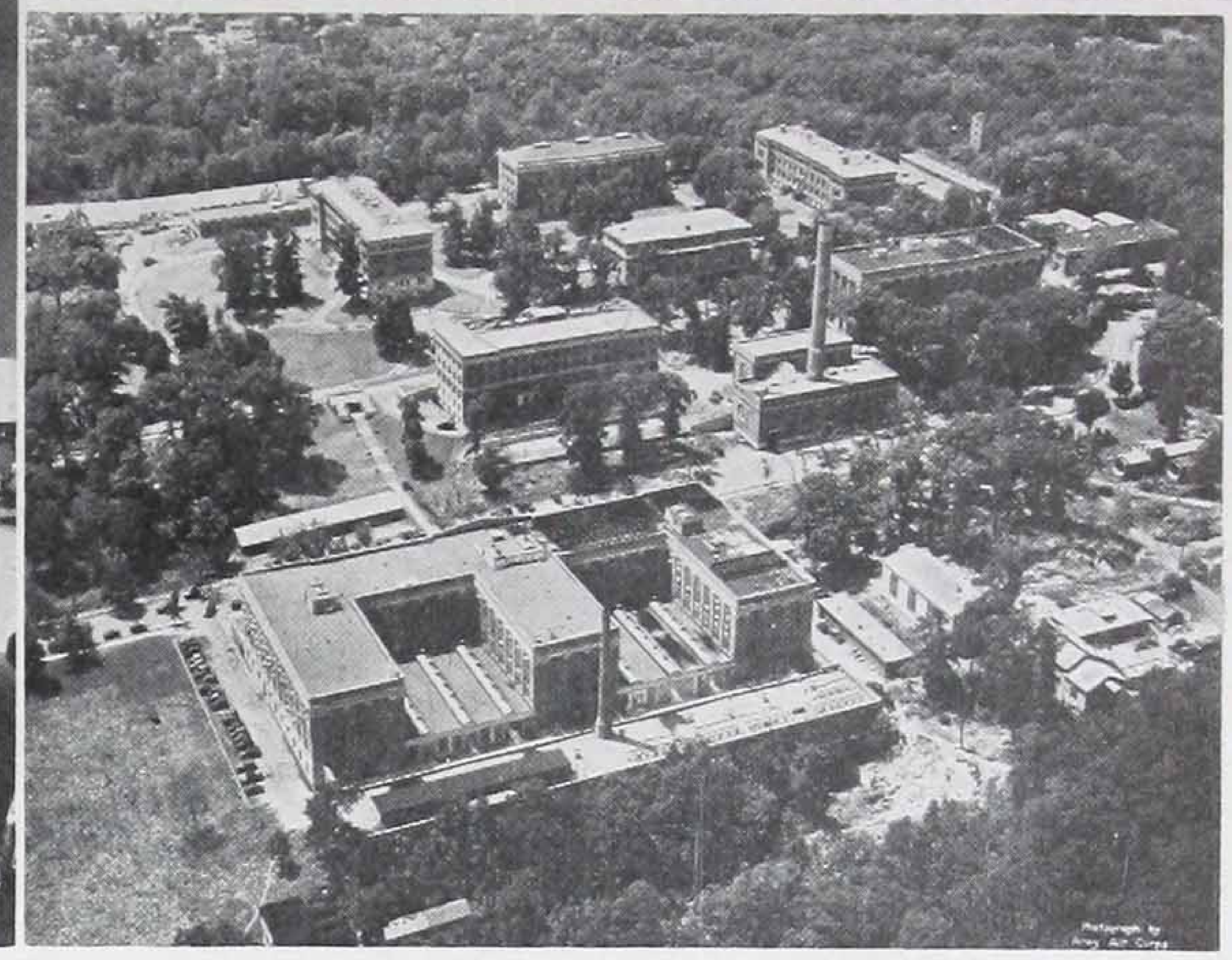


Fig. 127—Frick Air Conditioning Aids in Making Accurate Measurements and Tests at the U. S. Bureau of Standards, Washington, D. C.

CONTROLLED-AIR-VOLUME SYSTEM

This applies very well to office buildings and other cooling loads which involve but little moisture. Regulation is obtained by varying the volume of the conditioned air some 30 per cent as it leaves the fan.

Fresh air and recirculated air are proportioned by hand-set dampers in the inlet ducts. (This also applies to the two systems described below.) All the air passes through the filters and cooling coils: a thermostat starts and stops the compressor. As the humidity rises, a humidistat partially closes the automatic fan-outlet damper, cooling less air through a wider range. The moisture content is more accurately controlled (than is possible by thermostat alone) simply and automatically; the system is comparatively inexpensive to install, and needs little attention.

AUTOMATIC BYPASS SYSTEM

This is recommended for loads having high latent heat, as where quantities of water vapor are given off in process work, or there are large groups of people.

A modulating thermostat in the conditioned space controls a modulating motor on the bypass damper as the temperature changes: the amount of air passed through the cooling coil can be varied up to 60 per cent. The total air volume handled remains constant, which simplifies distribution into many small rooms.

An auxiliary switch on the motor-operated damper starts the compressor when the bypass damper is closed, and stops the machine when the damper is opened wide. A dewpoint thermostat can be wired in series with the auxiliary switch, to keep the compressor shut down as long as the dewpoint is low enough to give the humidity wanted; this saves refrigeration. The entire bypass arrangement is patented, and is widely used.

DIRECT SYSTEM

This is of special use where the load is high for the amount of air circulated, and there is much latent heat. Rooms with low ceilings and a heavy moisture content are most satisfactorily conditioned by the direct system, which also commends itself wherever the ultimate in comfort is desired.

The air volume handled is constant, and all of it goes through the cooling coils. If the resulting temperature is too low it is raised as needed by the reheating coils, which pick up heat from the incoming fresh air. A thermostat controls the compressor; a humidistat controls the reheating water pump.

The accurate control made possible can hardly be duplicated in any other system. The direct system prevents unduly low temperatures when air must be dried by cooling. It costs more, but for heavy and varying loads it is worth the difference.

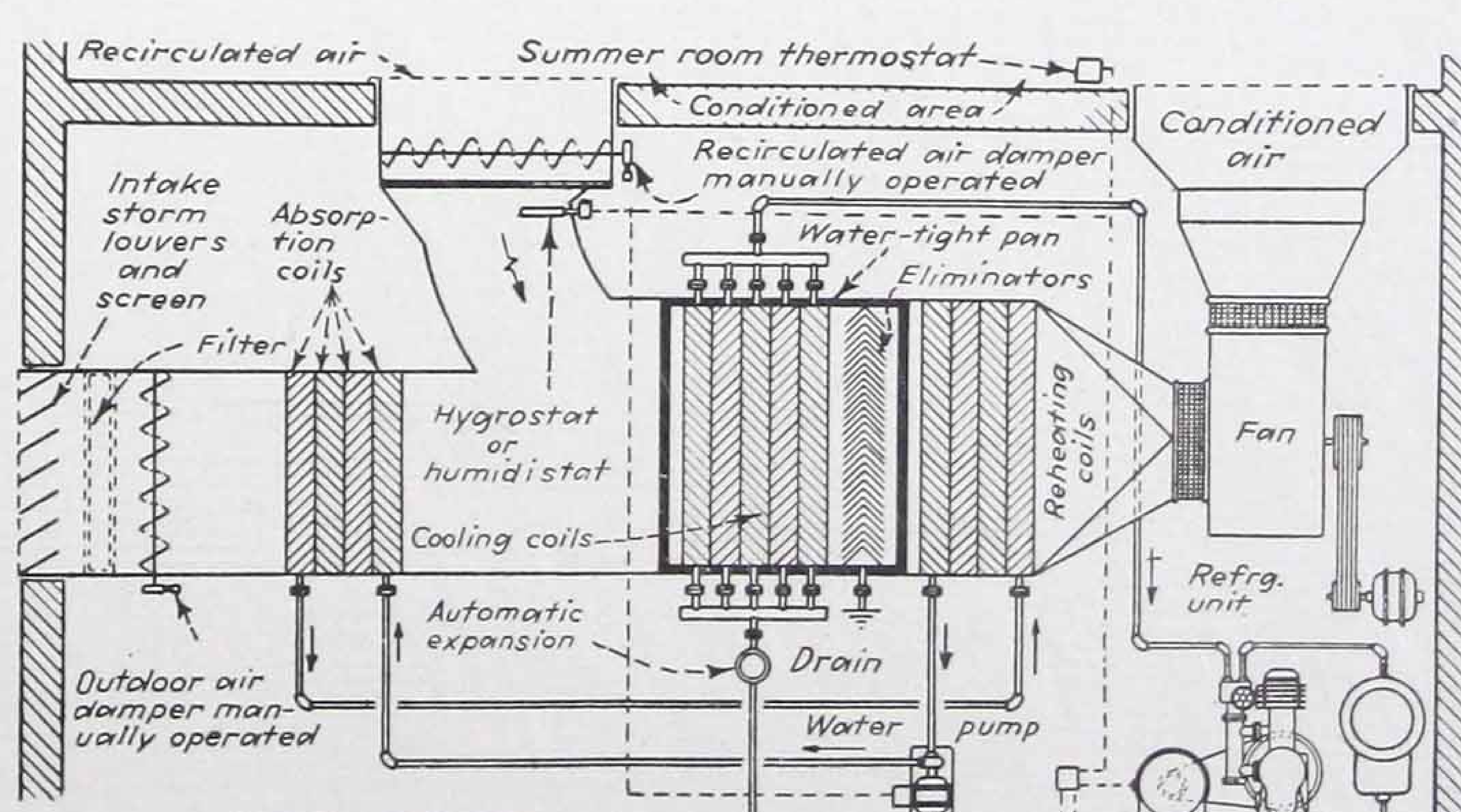


Fig. 128—The most Accurate and Complete Air Conditioning Arrangement

Fig. 129—The World's Largest Plant of Its Kind, at Oklahoma City, Oklahoma, Has Frick-Knickerbocker Equipment and over 6700 Lockers.

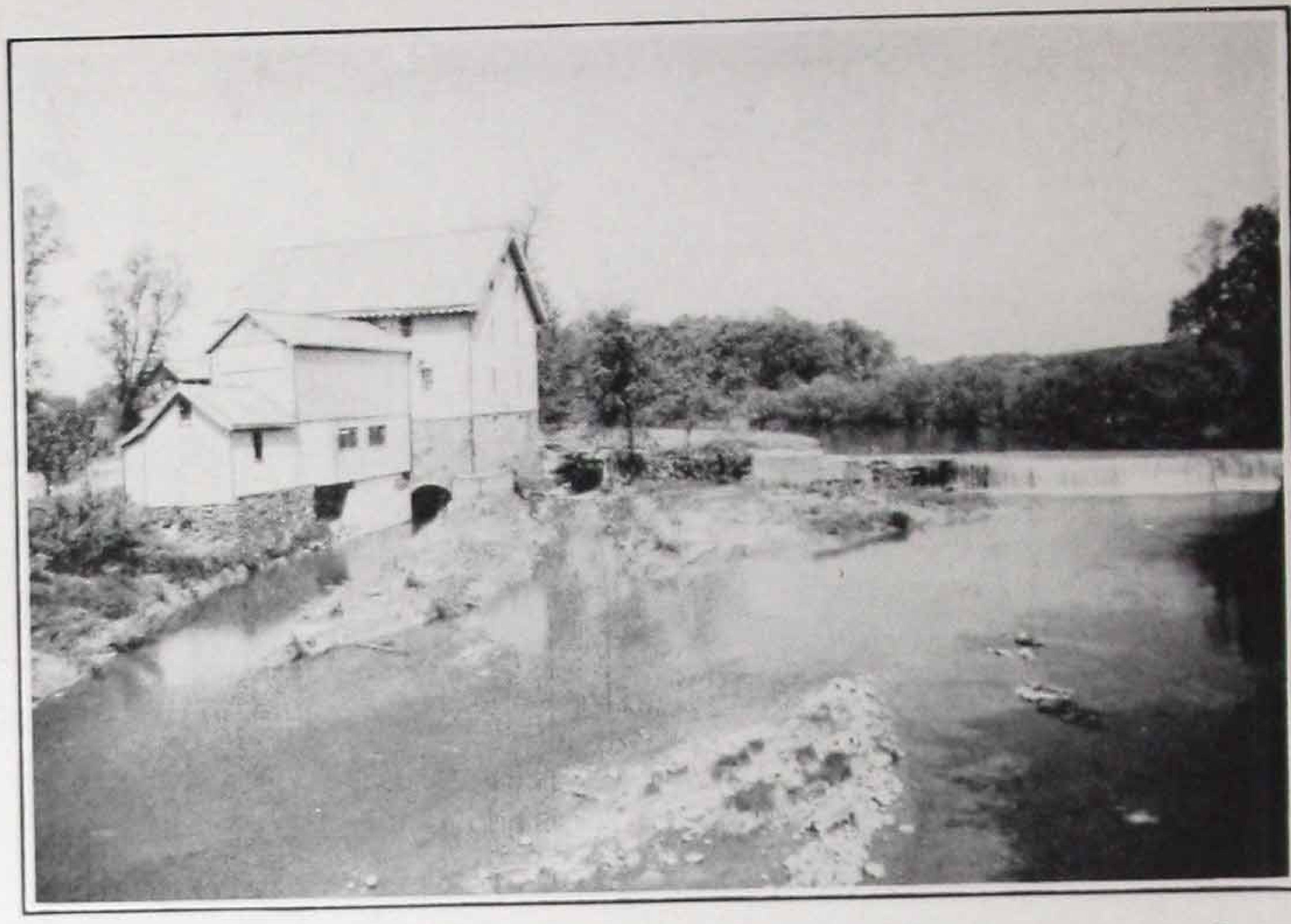


Fig. 131—This Old Mill Earns $3500 Annually from its Locker Service. Water Power Drives the Two Frick Refrigerating Machines.

Refrigerated Food Lockers

Since a family can save up to $100 a year by storing foods in one of these compartments, in a room kept at 0-10 deg. F., it is small wonder that hundreds of thousands of frozen-food lockers are now in use. There are already more locker systems than ice plants, in the U. S. Rental charges average $12 annually, but vary from $3 to $18 or more, depending on size and location.

Ice and cold storage plants, creameries, ice cream factories, and meat markets all find lockers a natural adjunct to their business; other installations are made for lockers alone.

Larger locker plants often include separate rooms for the chilling, ageing, cutting, blanching, and quick-freezing of meats and other foods: the operator charges a few cents a pound for these special services, the total income from which frequently equals locker rentals. Sales of meat and frozen foods to renters also add income. A complete 500-locker plant costs about $25,000, but yields up to 50 per cent yearly return if all lockers are rented and extra services are utilized.

Frick-Knickerbocker steel lockers will last a lifetime; they are strongly made, with a beautiful baked enamel finish, and are easily cleaned. Channel-shaped flanges reinforce the drawers and doors: doors are plain or louvred, as ordered; hinges are concealed. The sides and back of locker sections are either plain, or are perforated at slight extra cost. Standard colors are: angle iron frames, black; sides, back, and shelves, grey; doors and drawer fronts, white. See full details in Bulletins 142 to 145.

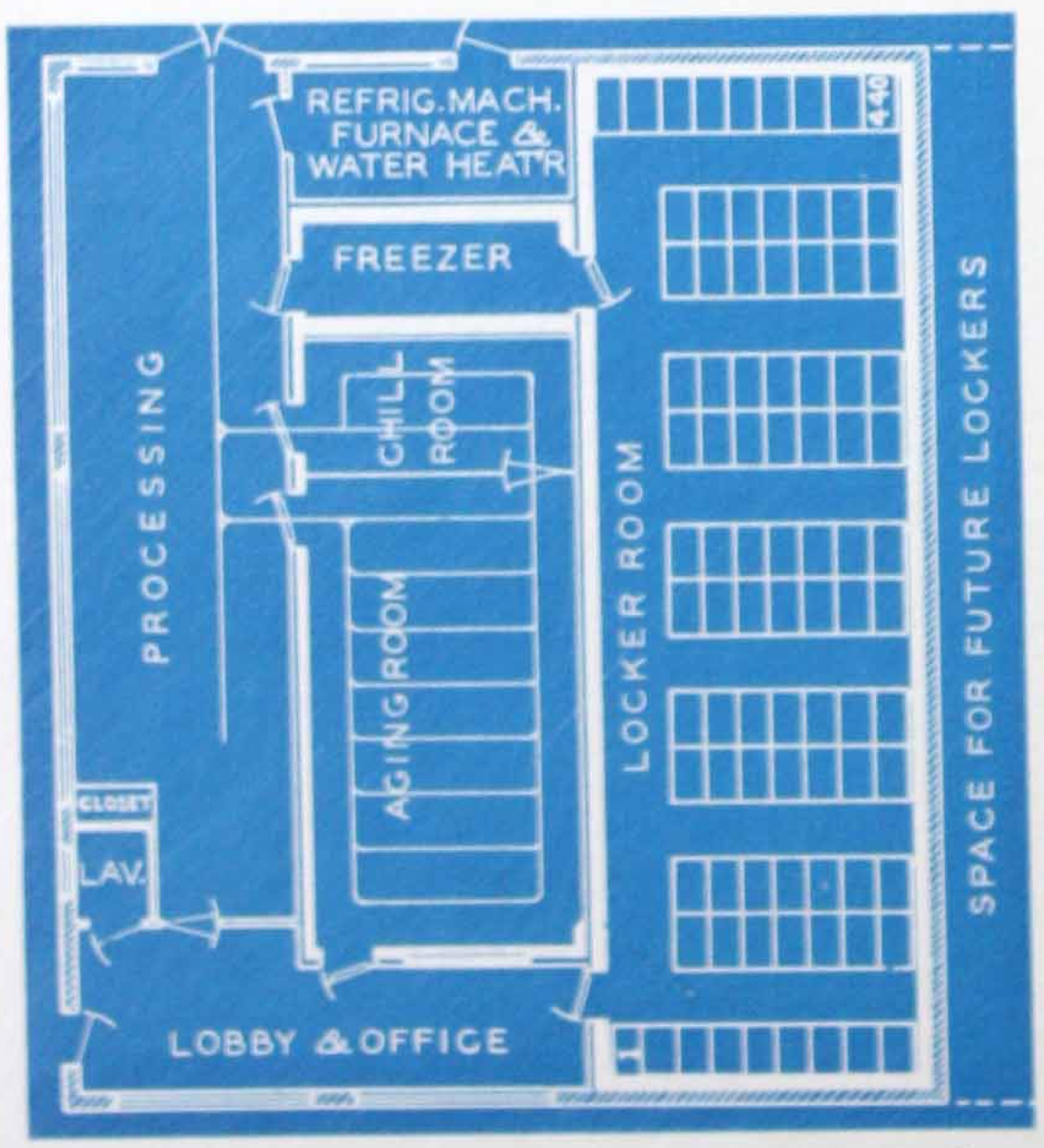


Fig. 130—Layout of a Typical Complete Locker Plant of Moderate Size. Some Plants Include Meat Killing, Smoking, and Curing Spaces.

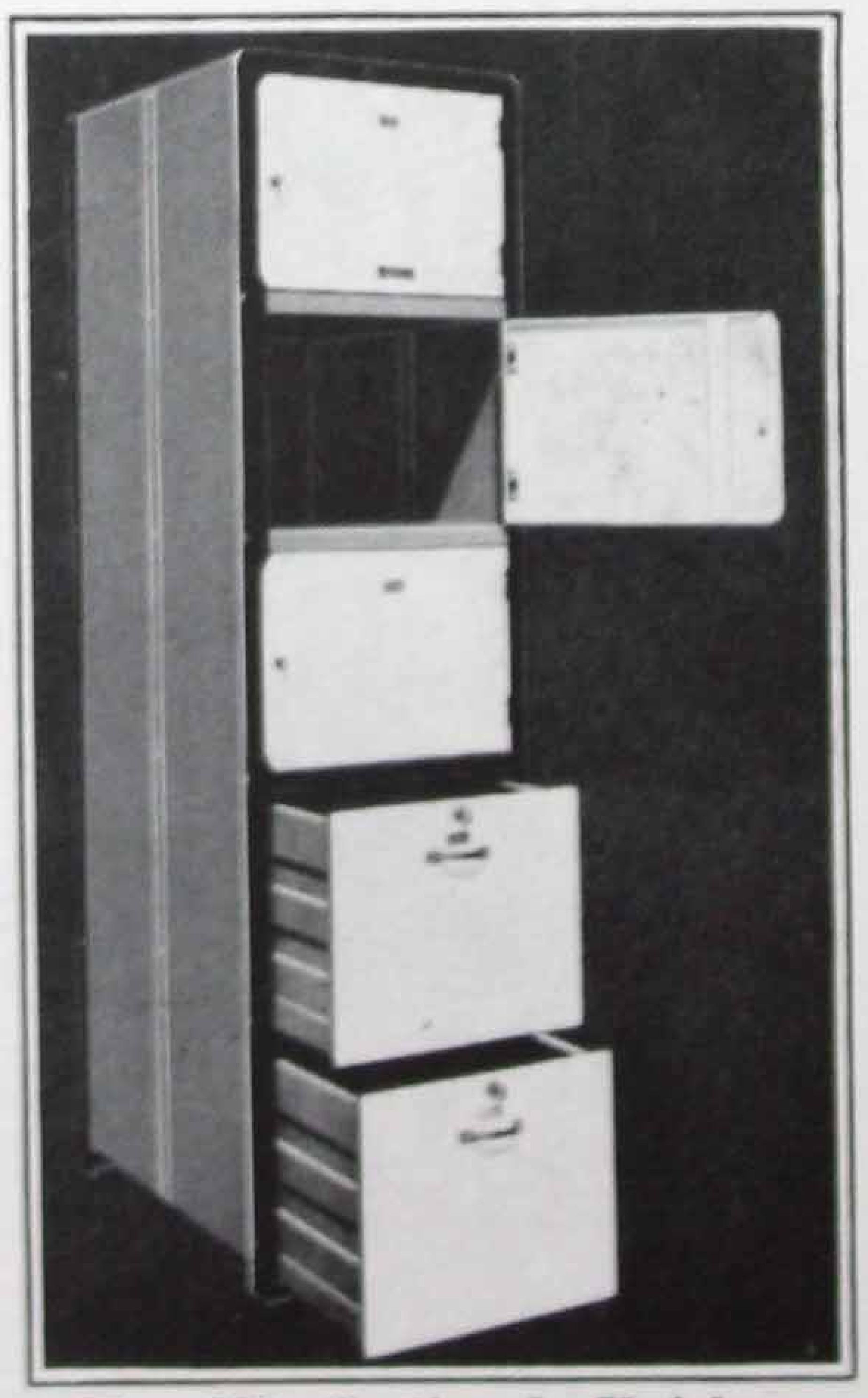


Fig. 132—Sectional Knickerbocker Locker with Three Doors and two Roller Drawers

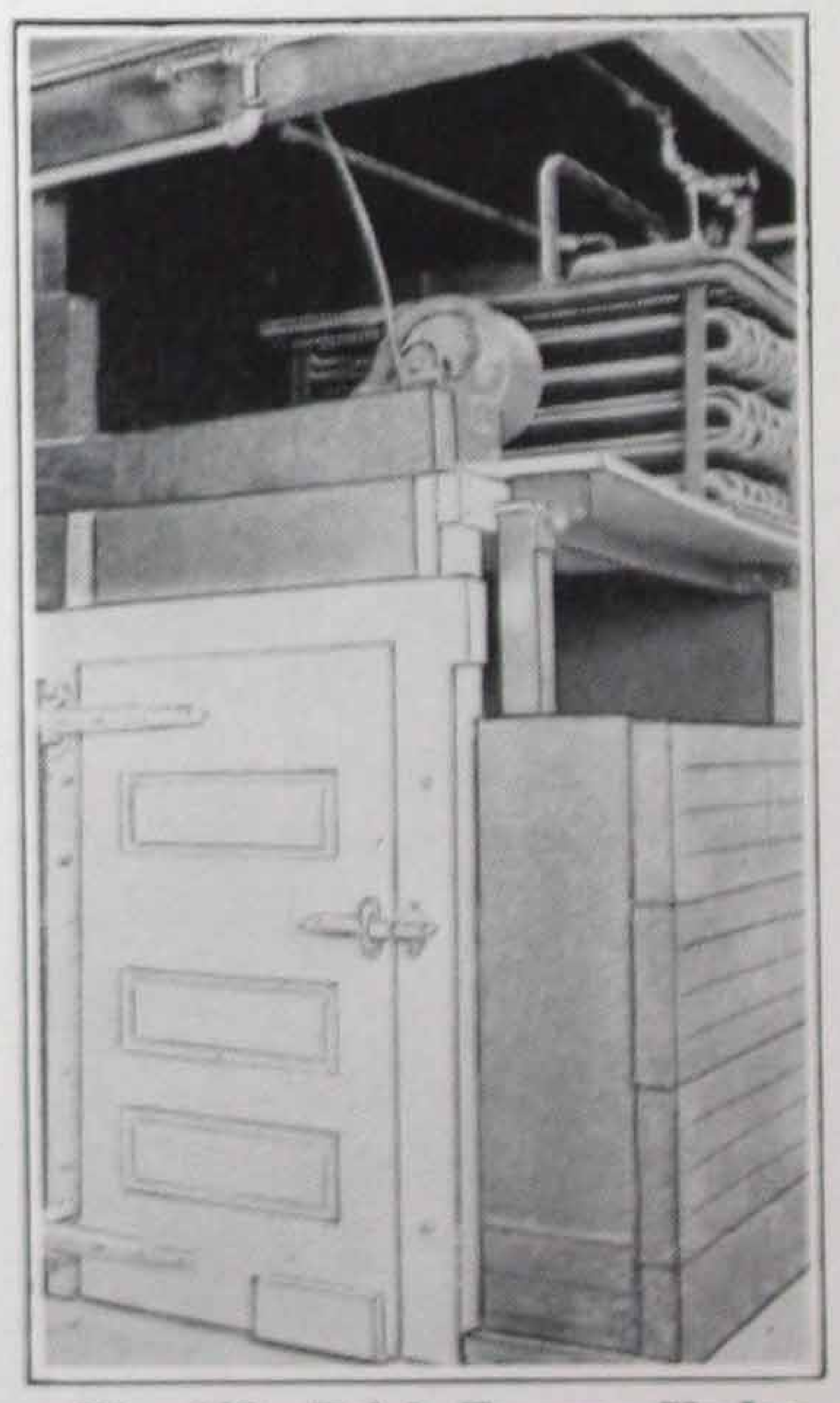


Fig. 133—Frick-Freezer Under Construction in a Locker Plant at Memphis, Mo.

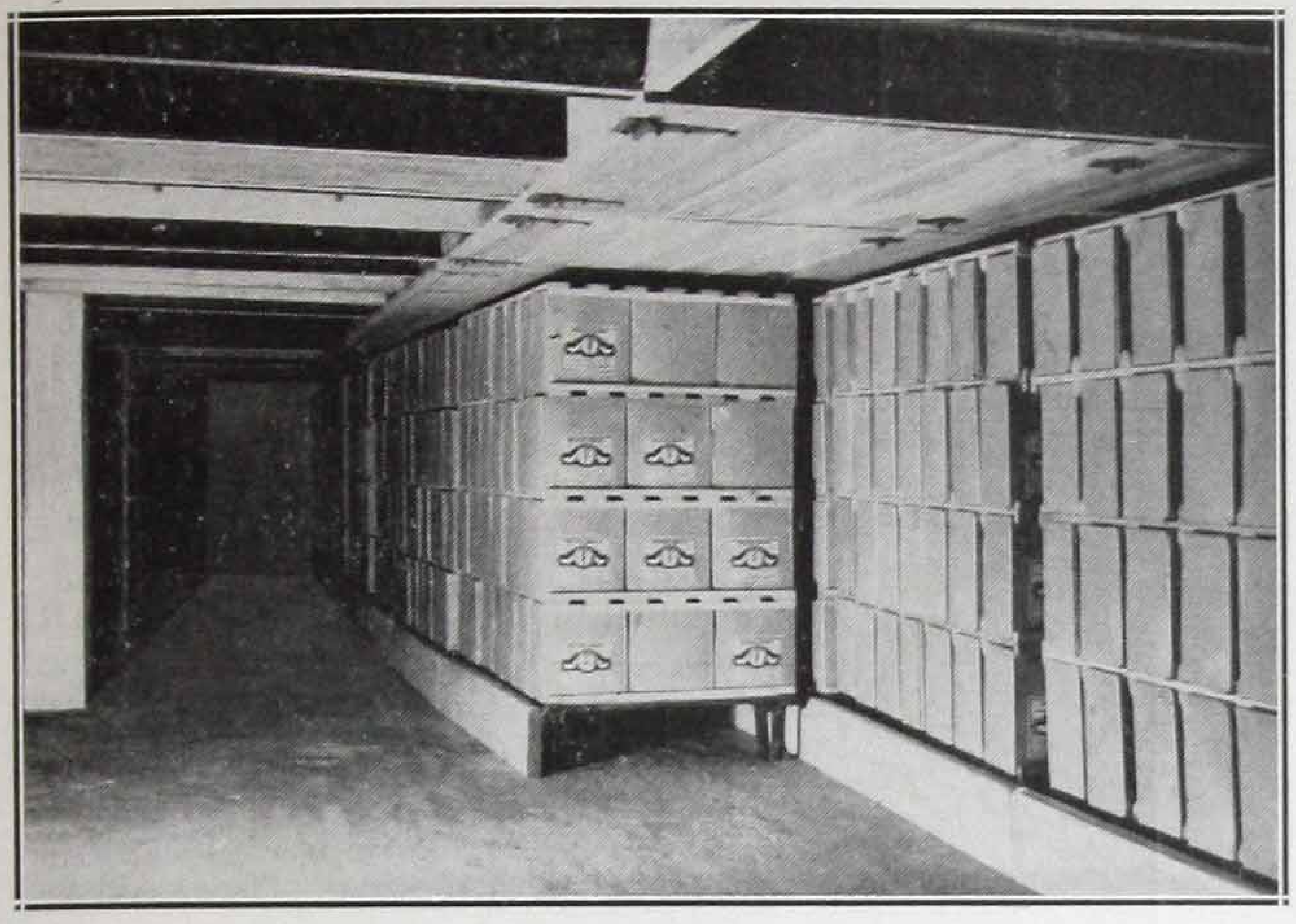


Fig. 134—Tunnel-Type Frick-Freezers Accommodate Either Push Trucks or Conveyors, Handle Any Product. Cooling Coils and Air Fans are Overhead. This Tunnel is Used for Quick-freezing Sliced Apples and Other Fruits.

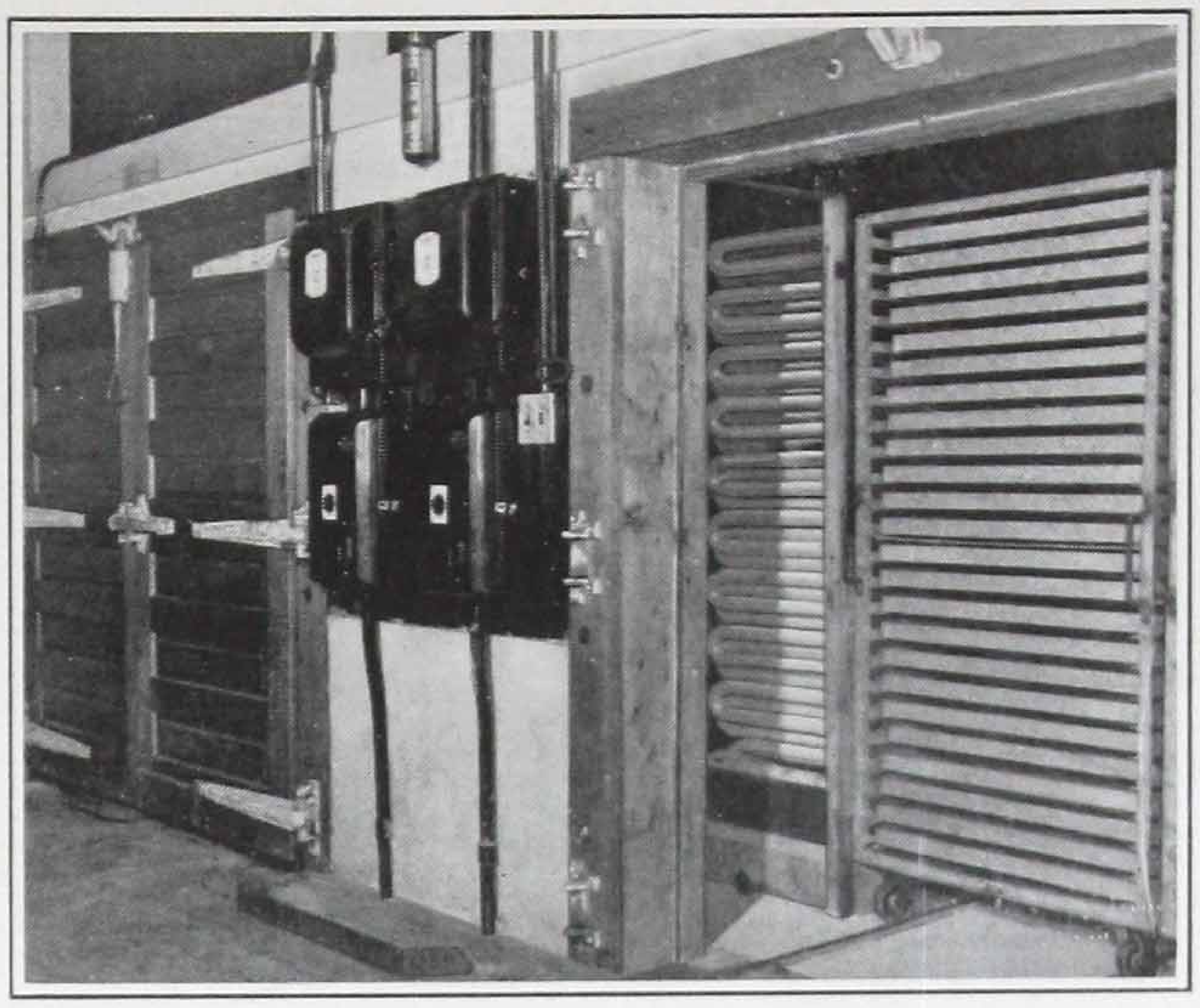


Fig. 136—Two Blizzard Freezers, Each Having a Pair of Push Trucks Containing Pans. Note Nested VW Cooling Coils.

Quick-Freezing Systems

The great quantities of frozen foods now in demand (they are being consumed by the millions of pounds every day) make a real opportunity for the plant having a quick-freezing system. Frick equipment of this type is installed in scores of the largest and most successful quick-freezing plants in existence—handling fruits, vegetables, meat, fish, shrimp, poultry, eggs, ice cream, and other foods.

The largest quick-freezing plant in the world, that of the Seabrook Farms - Deerfield Packing Co., at Bridgeton, N. J., uses Frick refrigeration throughout. Beginning with the 1946 season, this great plant will quick-freeze 1,000,000 lb. of fresh foods per day.

While we can furnish special kinds of quick-freezers to meet any particular needs, one of the two standard types shown in the diagrams below will generally meet any requirements. Both types use very cold air as the cooling medium. The nested Frick VW coils (see page 23) are connected to a booster compressor, for maintaining temperatures as low as desired. Accurate tests have shown that very cold air can hold so little moisture that the foods being frozen are not dried out: 44,000 lb. of turkeys, loosely wrapped in one sheet of waxed paper, lost only 1/3 of one per cent in weight when frozen in a blast of air at minus 30 deg. F.

Tunnel-type freezers generally have the coils overhead: the fans can be at the ends, or in rows along the sides. The foods are handled either in batches or on continuous conveyors. See Bulletin 147.

Blizzard freezers use the batch principle; air at very high velocity is blown directly over the foods and through the coils by a powerful fan. The freezer occupies a small compartment. Freezing time varies from a few minutes to a few hours, determined largely by the product. Ask for Bulletin 148.

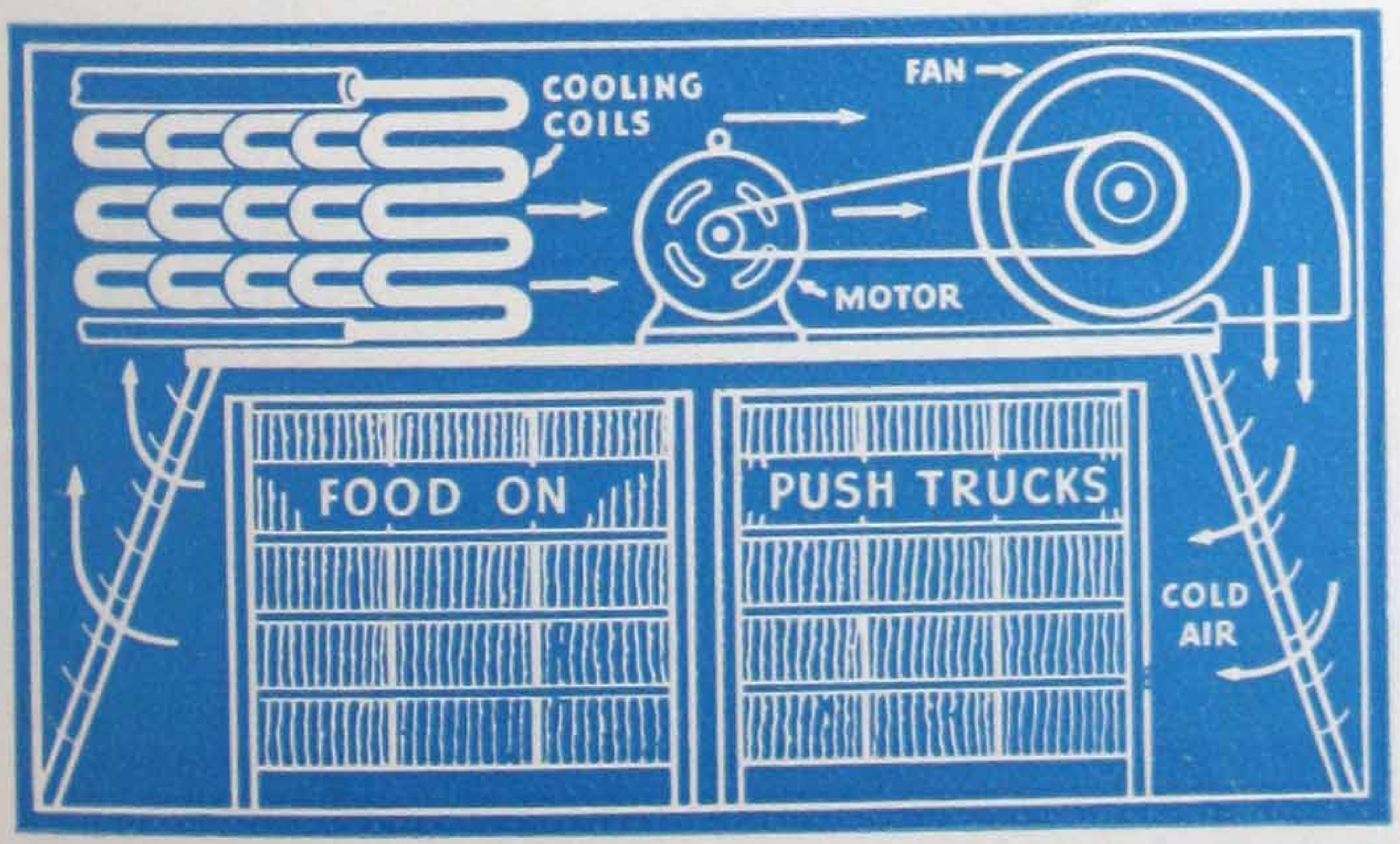


Fig. 135—Section Through a Frick Tunnel-Type Freezer. The Most Widely Used Design in the Industry.

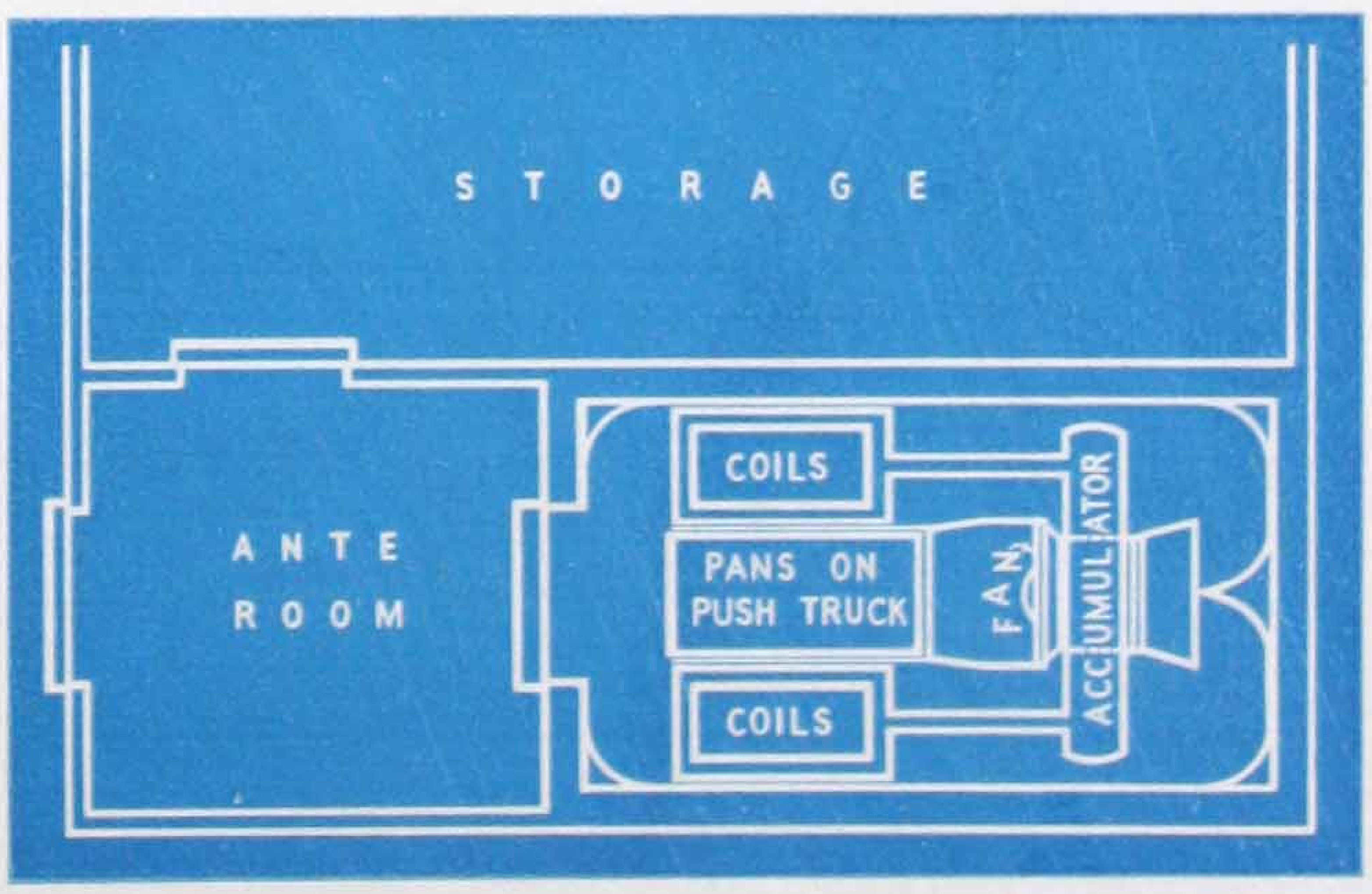


Fig. 137—Plan View of a Typical Single-Unit Blizzard Freezer, Complete with Ante Room and Frozen Food Storage

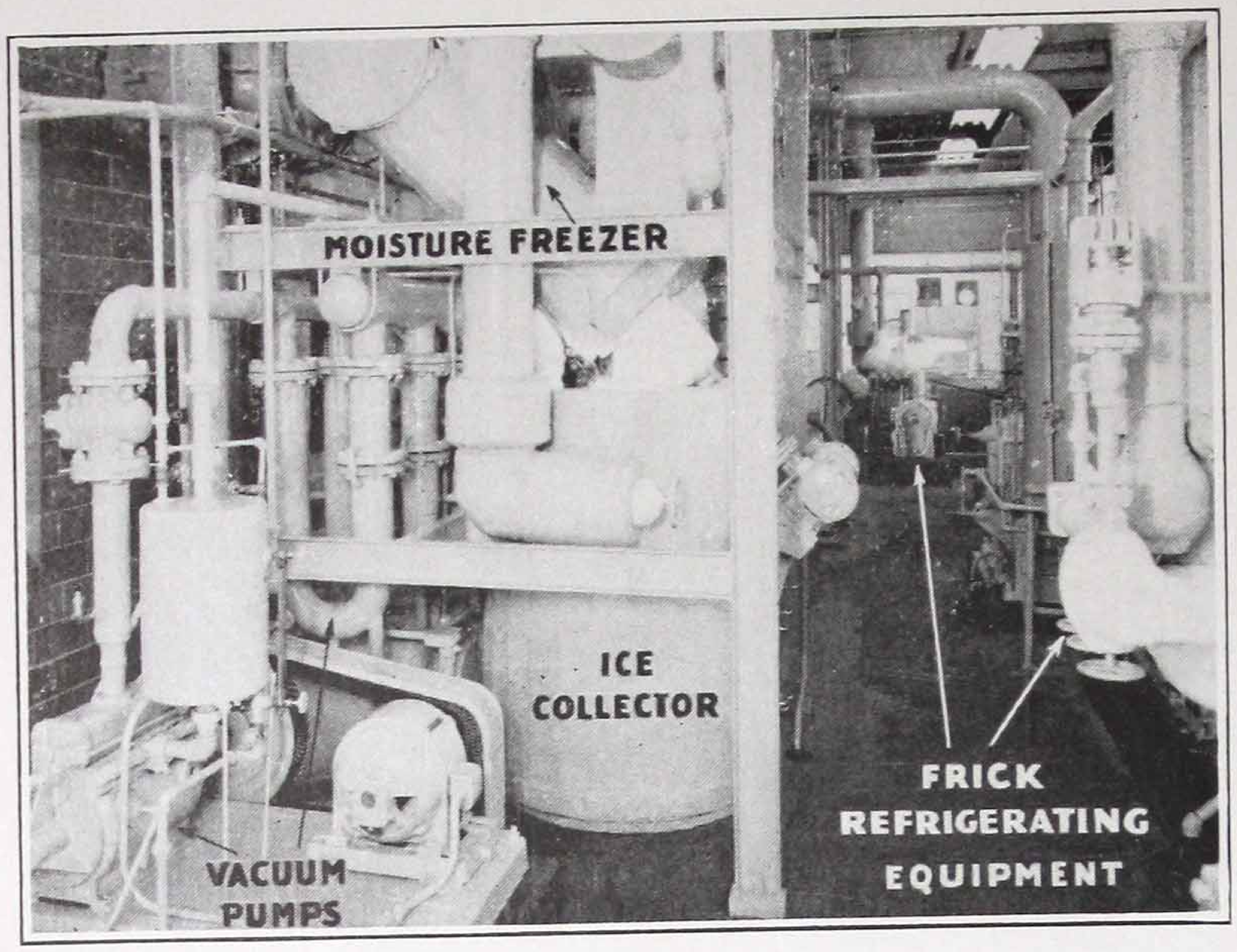


Fig. 138—Temperatures Down to 80 Deg. below Zero F. are Maintained with Frick Booster Compressors for Freezing the Moisture, under a Very High Vacuum, from Penicillin.

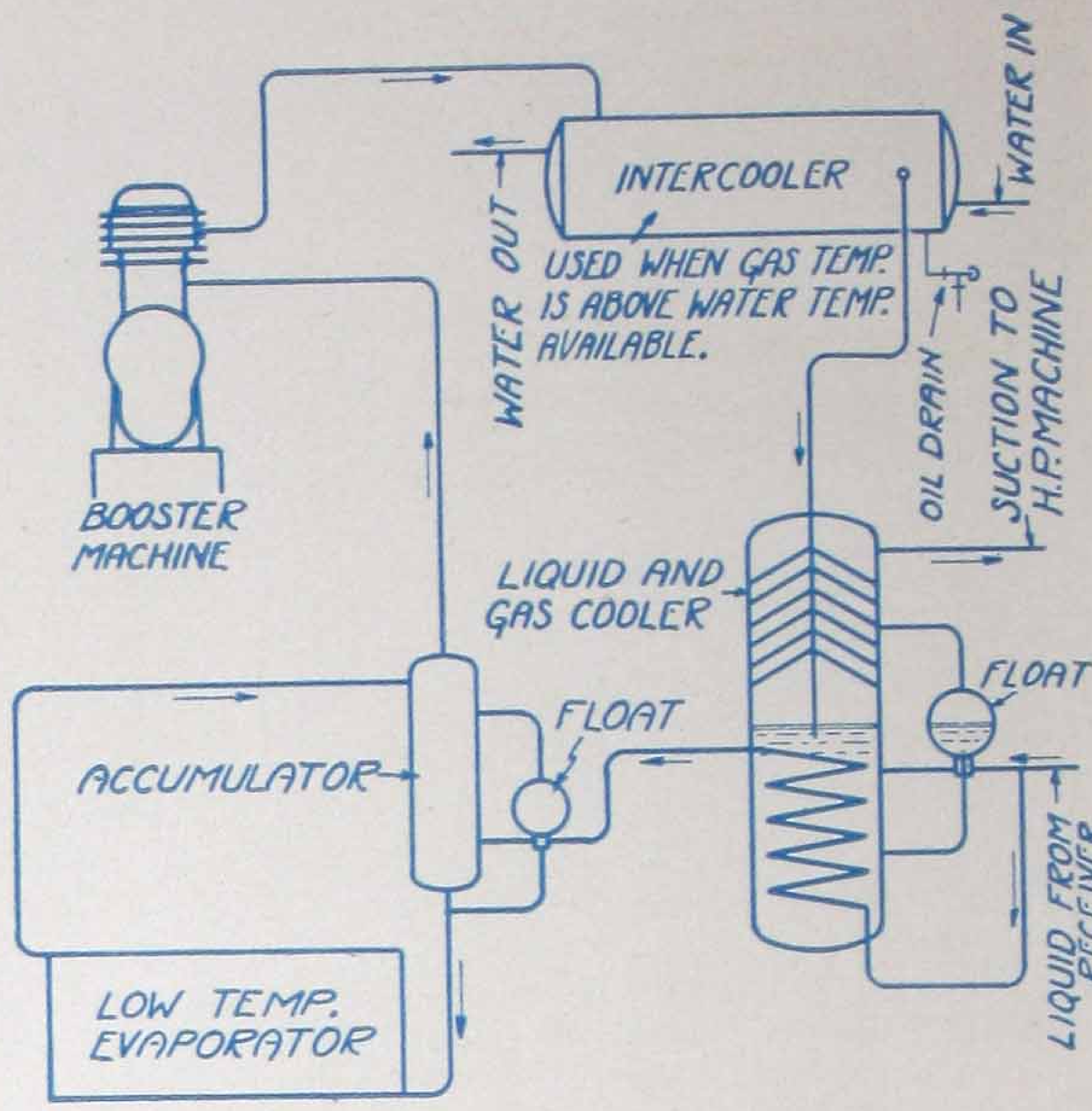


Fig. 141—The Standard Arrangement of the Frick Booster System for Producing Low-Temperature Refrigeration is Shown by this Diagram.

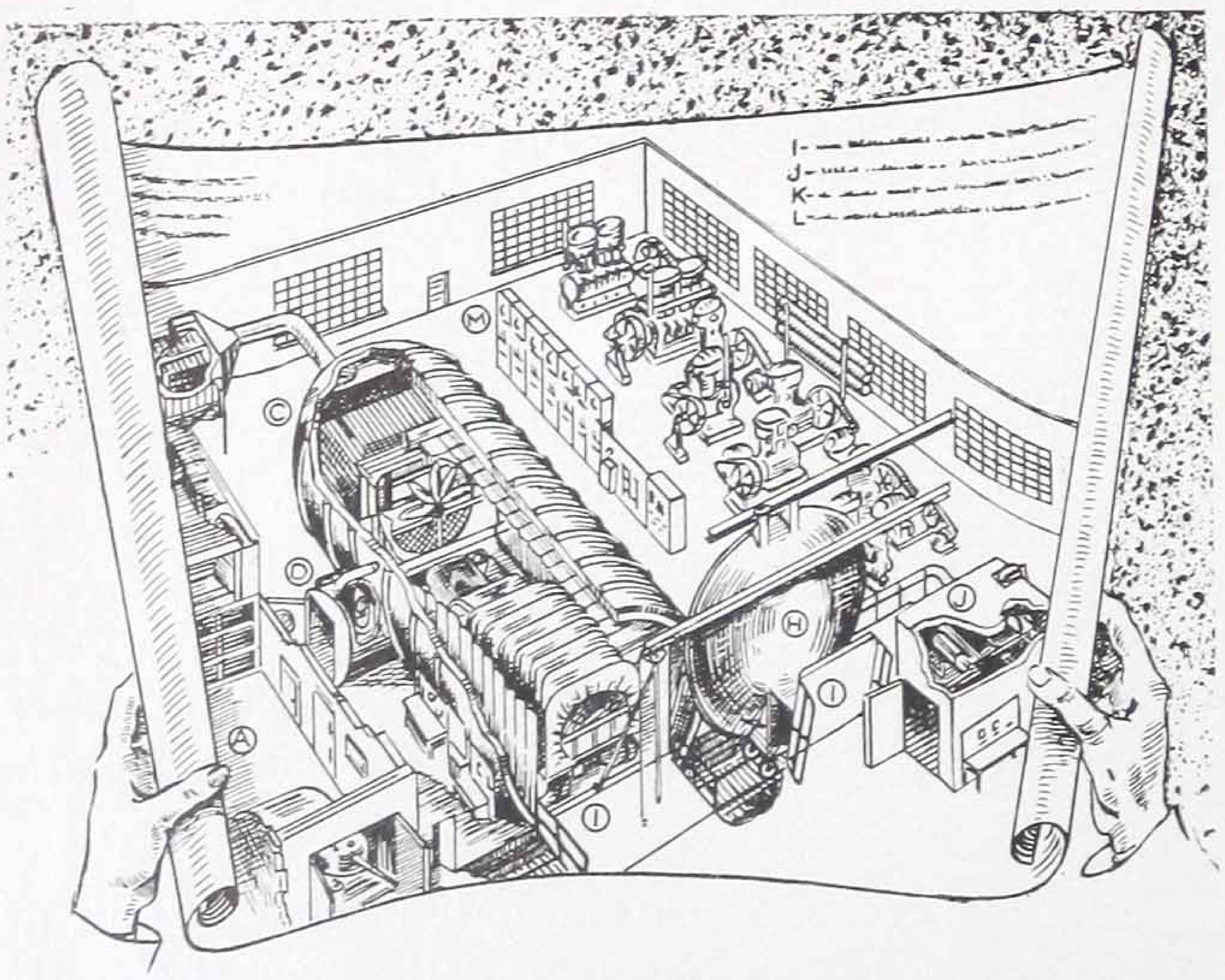


Fig. 139—Ten Compressors, in a 3-stage Booster Set-up, Hold any Desired Conditions in the Frick Arctic-Tropic-Stratosphere Laboratory of the U. S. Army.

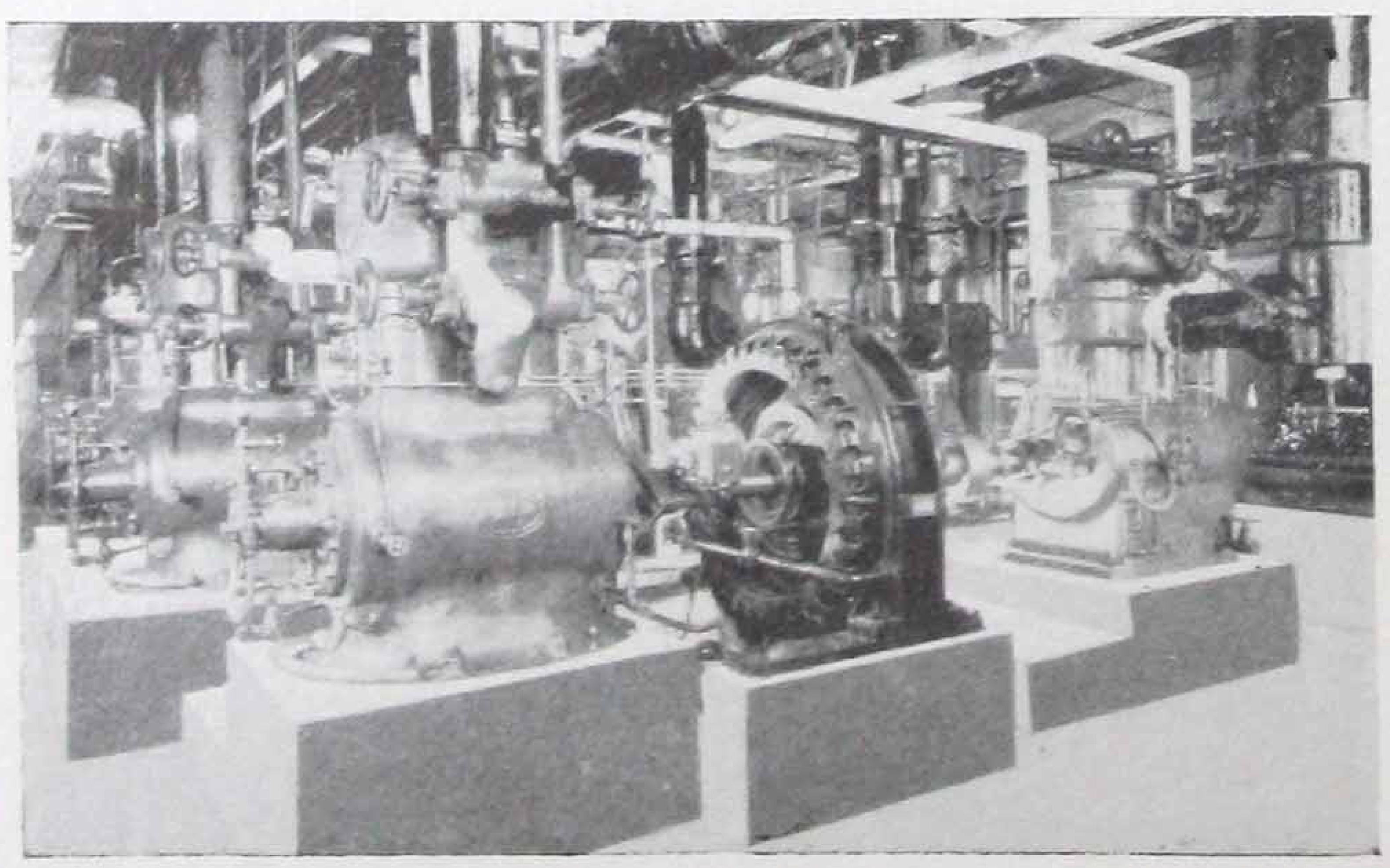


Fig. 140—The Seabrook Farms and Deerfield Packing Co. use 16 Large Frick Boosters and 13 Standard Frick Compressors in their Quick-Freezing and Low-Temperature Storage Operations at Bridgeton, N. J. Machines above are 9 to 9's Duplex-coupled to 15 by 10 Boosters.

Low-Temperature Booster Systems

In quick-freezing plants, and in low-temperature chemical and industrial processes, savings in horsepower up to 1/3 can be made by means of a booster system. In general, if ammonia must be compressed more than seven times above its original absolute pressure, it pays to install a booster or 2-stage system. Three or even four stages are used for holding temperatures of 70 to 100 or more degrees below zero F.

A booster machine takes the low-temperature, low-pressure gas and compresses or "boosts" it to a discharge pressure about four times higher. The gas is then cooled with cold water before entering a flash-type ammonia-cooled vessel, which completes the removal of the superheat before the gas enters the second-stage compressor. Coils in the bottom of the flash-type vessel subcool the liquid ammonia fed to the low-temperature evaporator. The proper design of these intercoolers and their controls is as important as the selection of the booster itself.

Frick booster compressors have the large gas volumes, light plate valves, and force-feed lubrication necessary for handling low-weight gas efficiently. Water or ammonia jacketed cylinders aid in removing the heat of compression. Larger machines are fitted with capacity controls when desired. Boosters are furnished in the same range of sizes as enclosed Freon-12 compressors, and have either two or four cylinders. See Bulletin 516.

Fig. 142—Ice Manufacture and Delivery.

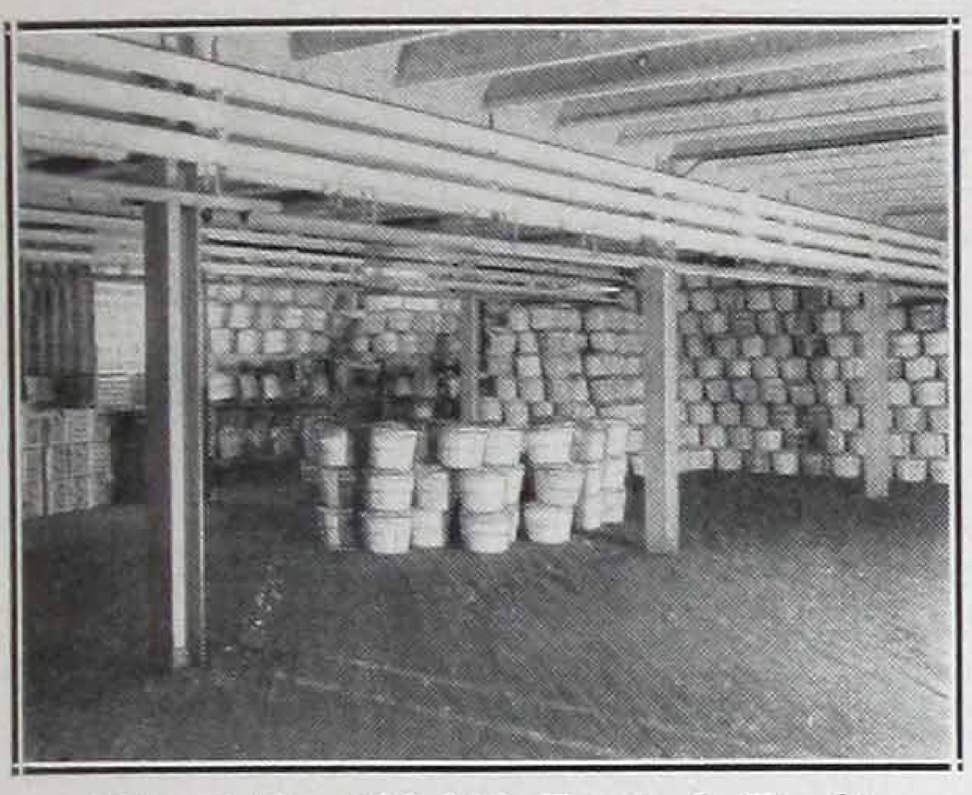


Fig. 143—100,000-Bushel Fruit Storage

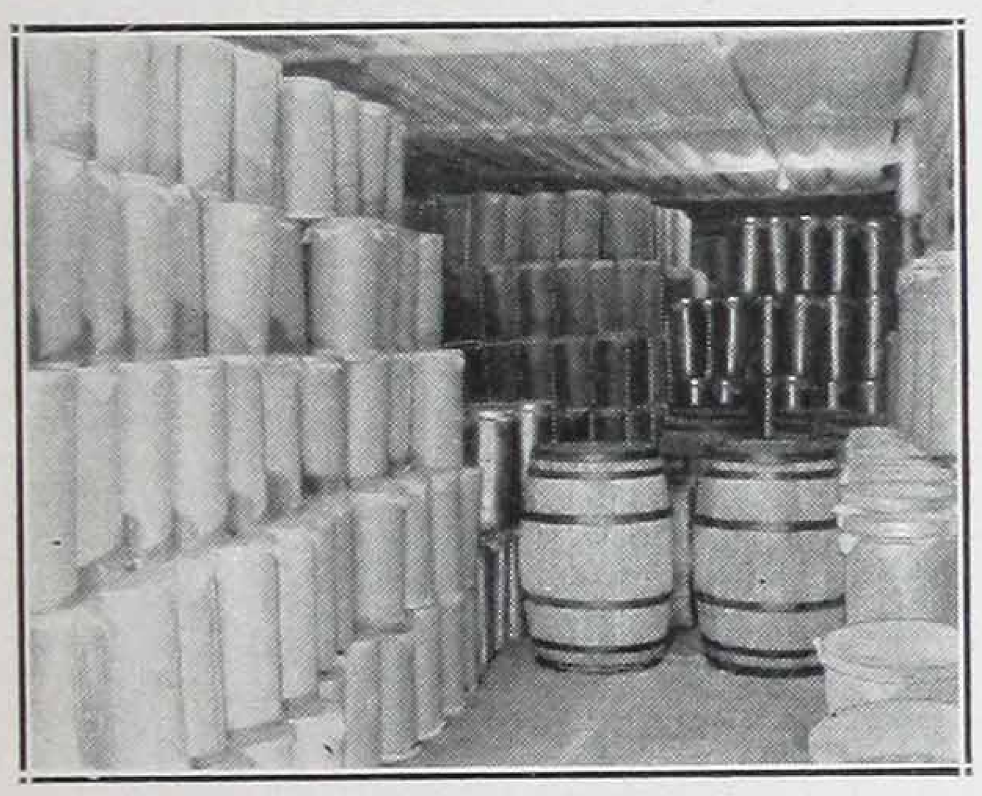


Fig. 144—Frozen-Food Storage

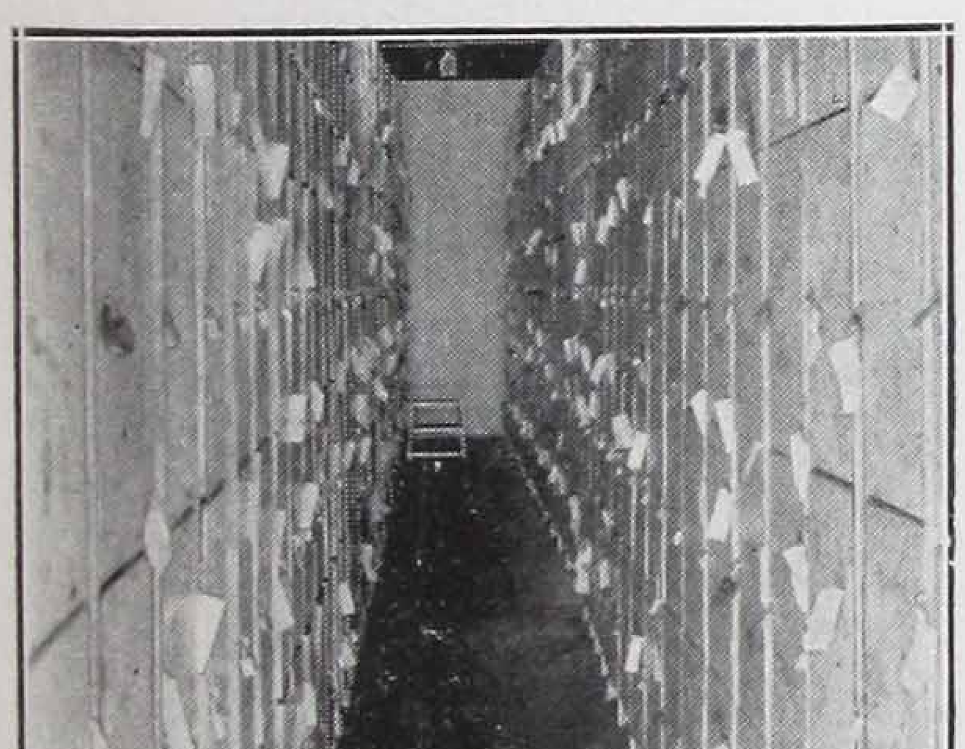
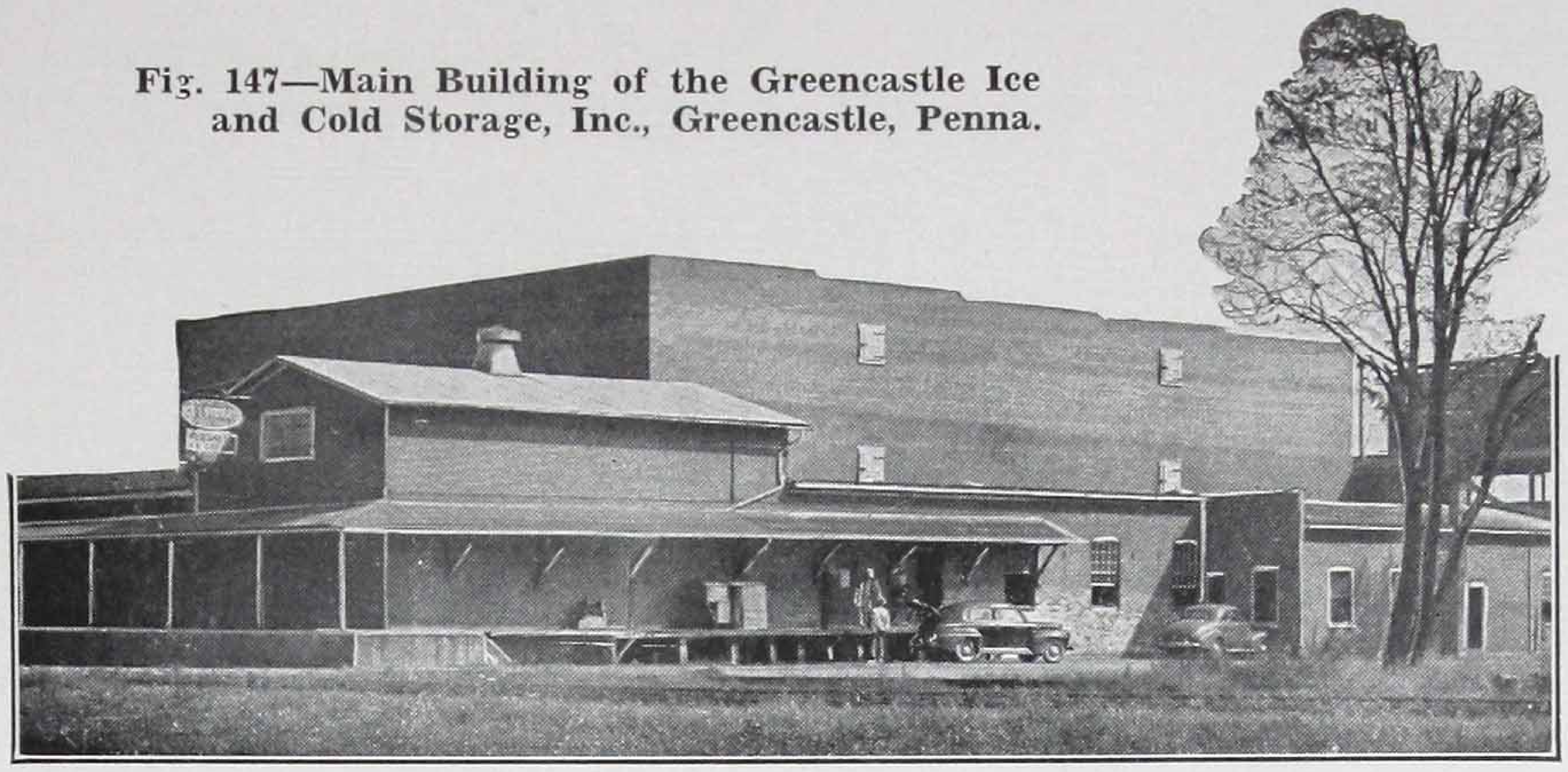


Fig. 145—1200 Refrigerated Food Lockers

Fig. 147—Main Building of the Greencastle Ice and Cold Storage, Inc., Greencastle, Penna.



How this plant serves a town of 2500 people as

The Community Refrigerating Center

An ice plant of only 10 tons capacity a few years ago, the Greencastle (Penna.) Ice and Cold Storage, Inc., now handles up to 80 tons daily, sells ice refrigerators, supplies farmers with ice for cooling milk, chills 600 tons of cherries in ice water for pitting, ices many refrigerator cars.

It stores 100,000 bushels of apples, and freezes big hogsheads of peaches and berries, all from its own packing house. Meats, poultry, vegetables, and cream are frozen and stored. Twelve hundred refrigerated lockers are rented. Fresh-killed calves and sheep (4000 per month) are chilled before being shipped.

The ice cream bar sells lunches; a cold room serves as a milk substation; beer was formerly handled at wholesale. Quick-freezing of locally grown foods in great quantities is the next step.

We believe every progressive town can profit from a similar COMMUNITY REFRIGERATION CENTER.

Bulletin 126 gives further examples of what a typical COMMUNITY REFRIGERATION CENTER can provide with the aid of Frick refrigerating, ice making, and air conditioning equipment. Such plants are ushering in a new day in community life—a day in which the benefits of adequate cooling service will be available to all.

Fig. 146—4000 Calves & Sheep Cooled Monthly

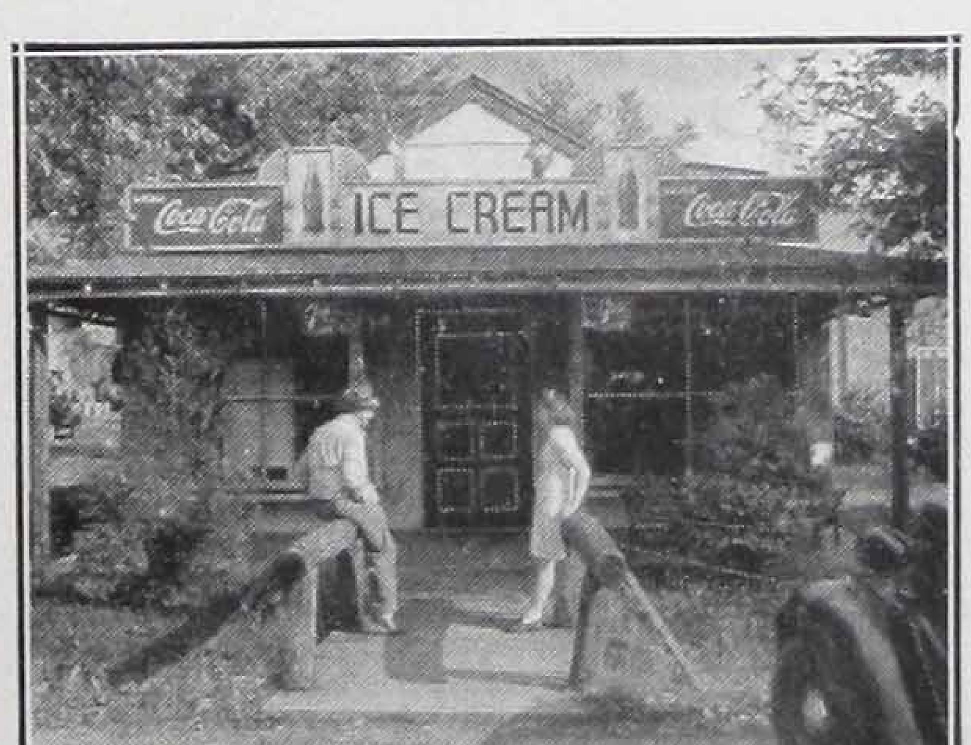


Fig. 148—Ice Cream Bar and Refrigerator Sales

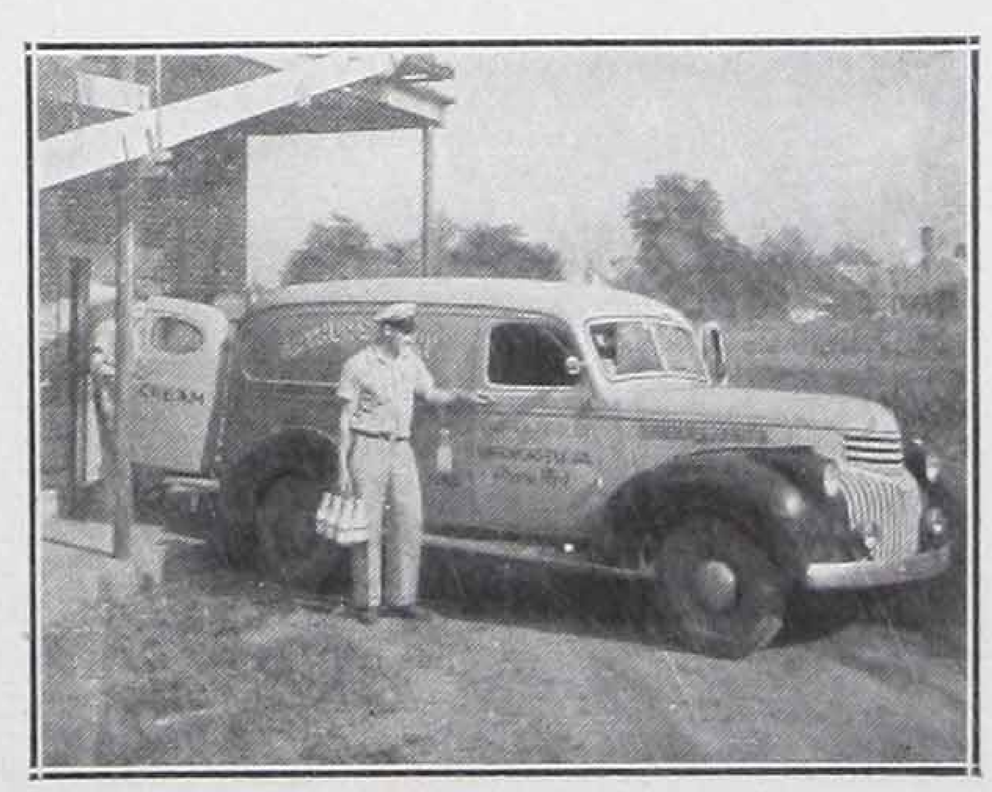


Fig. 149—Milk Substation

Useful Refrigeration Tables

FROM THE AMERICAN SOCIETY OF REFRIGERATING ENGINEERS

Table C. Properties of Saturated Ammonia

C-1 Pressure, Lb. per Sq. In. (Gage)	C-2 Temp., Degrees Fahr.	C-3 Volume of Vapor, Cu. Ft. per Lb.	C-4 Density of Vapor, Lb. Per Cu. Ft.	C-5 Heat Content, Above—40°	
				C-6 Liquid, B. t. u. per Lb.	C-7 Latent, B. t. u. per Lb.
27.9*	—105	223.1	0.0045	—66.6	635.7
27.5*	—101	190.1	0.0053	—62.5	633.5
27*	—97	161.9	.0062	—58.5	631.2
25*	—83.5	98.08	.0102	—44.9	623.5
22.5*	—72.3	66.52	.0150	—33.5	616.9
20*	—63.9	50.55	.0198	—25.3	613.3
15*	—51.4	34.5	0.0290	—12.2	605.3
10*	—42.1	26.3	.0380	— 2.2	599.0
5*	—34.5	21.4	.0468	+ 5.9	593.7
0	—28.0	18.0	.0555	12.8	589.3
5	—17.2	13.7	.0730	24.4	581.6
10	— 8.4	11.1	0.0902	33.8	575.2
11	— 6.9	10.7	.0937	35.5	574.0
12	— 5.3	10.3	.0971	37.1	572.9
13	— 3.8	9.96	.100	38.8	571.7
14	— 2.4	9,63	.104	40.4	570.6
15	— 1.0	9.32	0.107	41.9	569.5
16	+ 0.4	9.04	.111	43.4	568.5
17	1.7	8.78	.114	44.8	567.5
18	3.0	8.53	.117	46.2	566.5
19	4.3	8.28	.121	47.6	565.5
20	5.5	8.06	0.124	48.9	564.6
21	6.7	7.85	.127	50.2	563.7
22	7.9	7.65	.131	51.5	562.7
23	9.1	7.46	.134	52.8	561.8
24	10.2	7.28	.138	54.0	560.9
25	11.3	7.11	0.141	55.3	560.0
26	12.4	6.94	.144	56.5	559.1
28	14.5	6.63	.151	58.8	557.4
30	16.6	6.35	.158	61.0	555.8
32	18.6	6.09	.164	63.2	554.2
34	20.5	5.85	0.171	65.3	552.6
36	22.3	5.64	.177	67.3	551.1
38	24.1	5.44	.184	69.2	549.7
40	25.8	5.25	.191	71.2	548.2
42	27.5	5.07	.197	73.0	546.8
44	29.2	4.91	0.204	74.8	545.5
46	30.8	4.76	.210	76.6	544.1
48	32.3	4.61	.217	78.3	542.8
50	33.8	4.48	2.44	80.0	541.5
55	37.5	4.17	.240	84.0	538.4
60	40.9	3.91	0.256	87.8	535.4
65	44.2	3.67	.273	91.5	532.5
70	47.3	3.47	.289	94.9	529.7
75	50.3	3.28	.305	98.3	527.0
85	55.9	2.96	.338	104.5	522.0
95	61.1	2.70	0.370	110.4	517.1
100	63.5	2.59	.387	113.2	514.8
110	68.2	2.39	.419	118.5	510.3
120	72.6	2.21	.452	123.5	506.0
130	76.7	2.06	.494	128.2	502.0
140	80.6	1.93	0.517	132.7	498.1
150	84.4	1.82	.550	137.0	494.3
160	88.0	1.72	.582	141.1	490.7
170	91.4	1.62	.615	145.1	487.0
180	94.7	1.54	.648	148.9	483.6
190	97.8	1.47	0.681	152.6	480.2
200	100.9	1.40	.714	156.2	476.9
210	103.8	1.34	.747	159.6	473.7
220	106.6	1.28	.781	163.0	470.5
230	109.4	1.23	.814	166.3	467.4
240	112.0	1.18	0.848	169.4	464.4
250	114.6	1.13	.881	172.6	471.3
260	117.1	1.09	.915	175.6	458.4
270	119.6	1.05	.949	178.5	455.5
280	122.0	1.02	.983	181.4	452.6
290	124.3	0.98	1.018	184.2	449.8
300	126.5	0.95	1.052	187.0	446.9

Table D. Properties of Saturated Freon-12 (F-12)

D-1 Temp., Degrees Fahr.	D-2 Pressure, Lb. per Sq. In. (Gage)	D-3 Volume of Vapor, Cu. Ft. Per Lb.	D-4 Density of Vapor, Lb. Per Cu. Ft.	D-5 Heat Content, Above—40°	
				D-6 Liquid, B. t. u. per Lb.	D-7 Latent, B. t. u. per Lb.
—155	29.68*	232.29	0.004305	—24.61	84.61
—150	29.61*	179.79	0.005562	—23.50	84.07
—140	29.40*	110.92	009016	—21.29	83.01
—130	29.08*	70.94	.01410	—19.10	81.98
—120	28.61*	46.84	.02135	—16.94	80.98
—110	27.94*	31.84	.03141	—14.78	80.00
—100	27.01*	22.20	0.04504	—12.64	79.04
— 90	25.74*	15.86	.06305	—10.51	78.10
— 80	24.05*	11.57	.08640	— 8.40	77.17
— 70	21.84*	8.608	.1162	— 6.30	76.25
— 60	19.00*	6.516	.1535	— 4.20	75.33
— 50	15.42*	5.012	0.1995	— 2.11	74.42
— 40	10.92*	3.911	0.2557	0	73.50
— 30	5.45*	3.088	0.3238	2.03	72.67
— 20	0.58	2.474	.4042	4.07	71.80
— 18	1.31	2.370	.4219	4.48	71.63
— 14	2.85	2.177	.4593	5.30	71.27
— 10	4.50	2.003	0.4993	6.14	70.91
— 8	5.38	1.922	.5203	6.57	70.72
— 6	6.28	1.845	.5420	6.99	70.53
— 4	7.21	1.772	.5644	7.41	70.34
— 2	8.17	1.703	.5872	7.83	70.15
0	9.17	1.637	0.6109	8.25	69.96
2	10.19	1.574	.6352	8.67	69.77
4	11.26	1.514	.6606	9.10	69.57
5	11.81	1.485	.6735	9.32	69.47
6	12.35	1.457	.6864	9.53	69.37
8	13.48	1.403	.7129	9.96	69.17
10	14.65	1.351	0.7402	10.39	68.97
12	15.86	1.301	.7687	10.82	68.77
14	17.10	1.253	.7981	11.26	68.56
16	18.38	1.207	.8288	11.70	68.35
18	19.70	1.163	.8598	12.42	68.15
20	21.05	1.121	0.8921	12.55	67.94
22	22.45	1.081	.9251	13.00	67.72
24	23.88	1.043	.9588	13.44	67.51
26	25.37	1.007	.9930	13.88	67.29
28	26.89	0.973	1.028	14.32	67.07
30	28.46	0.939	1.065	14.76	66.85
32	30.07	.908	1.102	15.21	66.62
34	31.72	.877	1.140	15.65	66.40
36	33.43	.848	1.180	16.10	66.17
38	35.18	.819	1.221	16.55	65.94
40	36.98	0.792	1.263	17.00	65.71
42	38.81	.767	1.304	17.46	65.47
44	40.70	.742	1.349	17.91	65.24
46	42.65	.718	1.393	18.36	65.00
48	44.65	.695	1.438	18.82	64.74
50	46.69	0.673	1.485	19.27	64.51
55	52.04	.622	1.608	20.41	63.90
60	57.71	0.575	1.740	21.57	63.25
64	62.50	.540	1.851	22.49	62.73
68	67.54	.508	1.968	23.42	62.20
72	72.80	.479	2.090	24.37	61.65
76	78.30	.451	2.218	25.32	61.10
80	84.06	0.425	2.353	26.28	60.52
84	90.1	.401	2.495	27.24	59.94
88	96.4	.378	2.645	28.21	59.35
92	103.0	.357	2.799	29.19	58.73
96	109.8	.338	2.963	30.18	58.10
100	116.9	0.319	3.135	31.16	57.46
104	124.3	.302	3.316	32.15	56.80
108	132.1	.285	3.509	33.15	56.12
112	140.1	.269	3.714	34.15	55.43
116	148.4	.254	3.934	35.15	54.72
120	157.1	0.240	4.167	36.16	53.99
130	180.2	.208	4.808	38.69	52.07
140	205.5	0,180	5.571	41.24	50.00

*Inches of Mercury below one standard atmosphere (29.92 In.)
The total heat content of the vapor can be obtained by adding the heat of the liquid to the latent heat: this applies to both tables.

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Printed In U. S. A.

TABLE F.

UNITED STATES EQUIVALENTS

WEIGHTS

1 milligram equals	.01543 grain
1 gram equals	.03215 ounce, Troy
1 gram equals	.03527 ounce, avoirdupois
1 kilogram equals	2.20462 pounds avoirdupois
1 tonne equals	1.10231 net tons, 2000 pounds
1 tonne equals	.98421 gross ton, 2240 pounds

LINEAR MEASURE

1 millimeter equals	2.51968 64ths of an inch
1 centimeter equals	.39370 inch
1 meter equals	3.280833 feet
1 meter equals	1.093611 yards
1 kilometer equals	.62137 statute mile
1 kilometer equals	.53959 nautical mile

SQUARE MEASURE

1 square centimeter equals	.15500 square inch
1 square meter equals	10.76387 square feet
1 square meter equals	1.19599 square yards
1 hectare equals	2.47104 acres
1 square kilometer equals	.38610 square mile

CUBIC MEASURE

1 cubic centimeter equals	.06102 cubic inch
1 cubic decimeter equals	61.02338 cubic inches
1 cubic meter equals	35.31445 cubic feet
1 cubic meter equals	1.30794 cubic yards

CAPACITY MEASURE

1 liter equals	1.05668 fluid quarts
1 liter equals	.26417 gallon, 231 cubic inches
1 cubic meter equals	264.17047 gallons, 231 cubic inches
1 hectoliter equals	2.83774 bushels
1 cubic centimeter equals	.27051 fluid drachm
1 cubic centimeter equals	.03381 fluid ounce

MISCELLANEOUS

1 kilogram per lineal meter equals	.67197 pound per lineal foot
1 kilogram per square centimeter equals	14.22340 pounds per square inch
1 kilogram per square meter equals	.20482 pound per square foot
1 kilogram per cubic meter equals	.06243 pound per cubic foot
1 kilogram-meter equals	7.23300 foot-pounds
1 metric horsepower equals	.98632 U. S. horsepower

TABLE G.

COMPARISON OF THERMOMETER SCALES

Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.
—40	—40.0	4	39.2	28	82.4	53	127.4	78	172.4
—38	—36.4	5	41.0	29	84.2	54	129.2	79	174.2
—36	—32.8	6	42.8	30	86.0	55	131.0	80	176.0
—34	—29.2	7	44.6	31	87.8	56	132.8	81	177.8
—32	—25.6	8	46.4	32	89.6	57	134.6	82	179.6
—30	—22.0	9	48.2	33	91.4	58	136.4	83	181.4
—28	—18.4	10	50.0	34	93.2	59	138.2	84	183.2
—26	—14.8	11	51.8	35	95.0	60	140.0	85	185.0
—24	—11.2	12	53.6	36	96.8	61	141.8	86	186.8
—22	— 7.6	13	55.5	37	98.6	62	143.6	87	188.6
—20	— 4.0	14	57.2	38	100.4	63	145.4	88	190.4
—18	— 0.4	15	59.0	39	102.2	64	147.2	89	192.2
—16	+ 3.2	16	60.8	40	104.0	65	149.0	90	194.0
—14	6.8	17	62.6	41	105.8	66	150.8	91	195.8
—12	10.4	18	64.4	42	107.6	67	152.6	92	197.6
—10	14.0	19	66.2	43	109.4	68	154.4	93	199.4
— 8	17.6	20	68.0	44	111.2	69	156.2	94	201.2
— 6	21.2	21	69.8	45	113.0	70	158.0	95	203.0
— 4	24.8	22	71.6	46	114.8	71	159.8	96	204.8
— 2	28.4	23	73.4	47	116.6	72	161.6	97	206.6
0	32.0	24	75.2	48	118.4	73	163.4	98	208.4
+ 1	33.8	25	77.0	49	120.2	74	165.2	99	210.2
2	35.6	26	78.8	50	122.0	75	167.0	100	212.0
3	37.4	27	80.6	51	123.8	76	168.8		
				52	125.6	77	170.6		

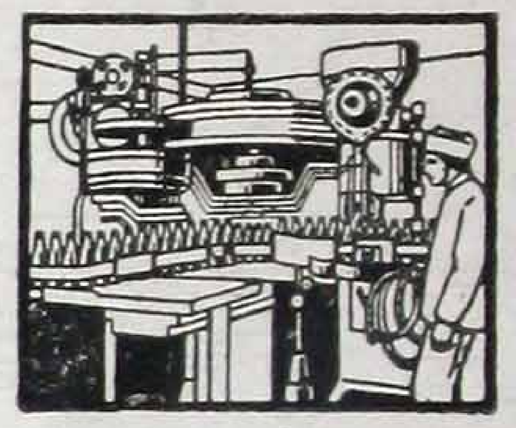
$C. = 5/9\ (F. - 32)$

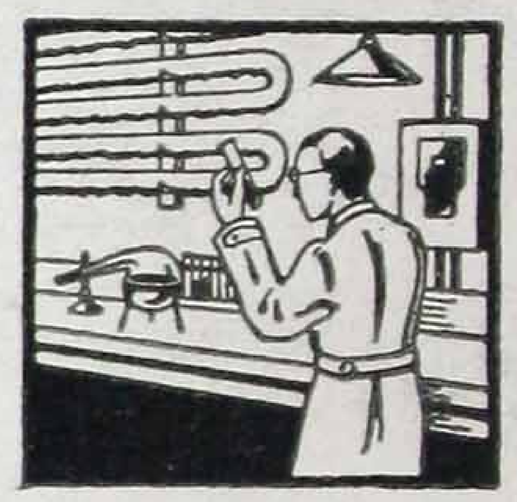
$F. = 9/5\ C. + 32$

TRADE FRICK MARK

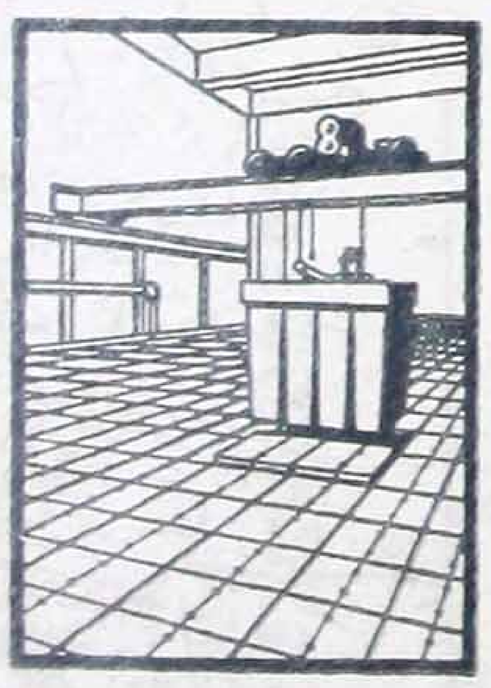
Refrigeration

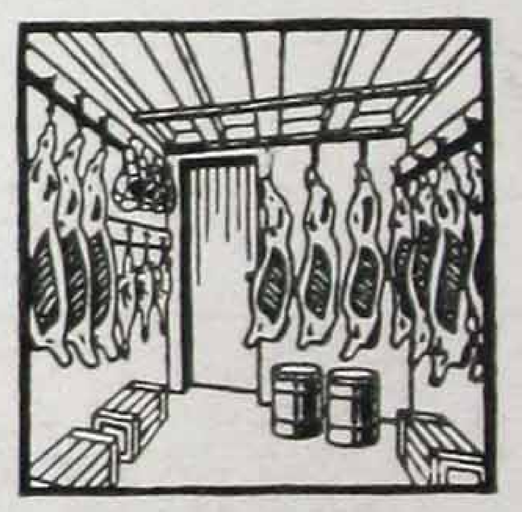
PERFORMS MANY VITAL SERVICES





- Air Conditioning
- Beverage Cooling
- Candy Making
- Cold Storage
- Food Service
- Freezing Ice Cream
- Fruit Precooling
- Locker Systems
- Low-temperature Work
- Making Ice
- Marine Refrigeration
- Milk Cooling
- Process Work
- Research and Testing
- Quick-freezing
- Water Cooling and Many Others





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